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THE INDEX SUPPLEMENT.

With this issue we present the Index to Volume 39, in the preparation of which unusual care has been taken, while, as will be seen, it occupies no fewer than twelve closely printed pages, owing to the thorough system of cross reference. The growing number of subjects of a scientific and industrial nature brought within the sphere of electricity, as well as the steady addition to the number of pages, renders the compilation of such an index as this increasingly more difficult. as it is always desirable to render consultation of it direct and easy. Aside from these considerations, an index is a pretty good indication of the drift of things, and the waxing and waning of interest in different topics. We may point out that as an auxiliary to this regular index of the volume, we are now printing every week a catalogue card index of the leading contents of the previous week, convenient for inclusion in a card index.

A. A. A. S. PITTSBURG MEETING.

Elsewhere we print an account of the recent Pittsburg meeting of the American Association for the Advancement of Science, which meeting undoubtedly ranks as one of the most successful in the history of the body, both with respect to the character of the attendance and the value of the papers presented. Very much of this success has been due to the excellent work of the local committee and its efficient secretary, Mr. Geo. A. Wardlaw, whose efforts were seconded by a large sum contributed by public-spirited citizens of Pittsburg. Moreover, a real effort was made to aid the press in giving proper publicity to the proceedings, and we are consequently enabled to print in our columns a fuller account of the meeting of the Association than has been possible any time in the past. This matter of publicity also received attention on the part of the governing body, and we are glad to know that by unanimous vote a press secretary was provided for each section, whose duty will be to obtain in advance of reading, papers or abstracts thereof for purposes of publicity. The real necessity which led to this measure is obvious when it is considered that the various sections meet during the same hours, and that very many papers are read only by title. Consequently, to obtain a satisfactory report of the proceedings from notes taken during sessions has been impossible, and the attempt has rarely been made. The unfortunate result has been that most of the papers contributed to the A. A. A. S. might as well never have been written so far as concerns the dissemination of the knowledge contained. The section on physics anticipated action on this point, and it is through its press secretary, Mr. Geo. F. Stradling, that we are enabled to present a full account of all the more important papers on electrical and cognate subjects read in that section.

In considering the subject of press secretaries, the governing body might well have gone a step further and provided for a general office or routine secretary, to care for the interests of the association between meetings. Abundant occupation should be found for such an officer in the publication of the *Transactions*, enlarging the membership by solicitation through proper channels, co-operating with the section press secretaries and local committees, and, above all, in keeping the association before the public through press notices, particularly during the several months preceding a meeting. The secretary of the local committee appears to have performed this work admirably for the Pittsburg meeting, so far as the opportunity would permit, but this important duty, as well as many other

matters that in the past have not received adequate attention, require the services of a permanent official corresponding to the office secretary of the various professional bodies of the country. In other words, there is a crying need for a business and routine secretary, all of whose time should be devoted exclusively to the interest of the Association. It is undeniable that up to the present the American Association for the Advancement of Science has in prestige lagged far behind the corresponding British body. This we firmly believe to be due, not to innate inferiority, but to defects in organization and administration, the correction of which we hope will soon be seriously undertaken by the governing body.

MARCONI ON WIRELESS TELEGRAPHY.

In this issue we print the concluding portion of Mr. Marconi's lecture before the Royal Institution of London, in which are set forth the more recent developments of his system of wireless telegraphy. The new form of wave detector described involves a very interesting principle. In the coherer, the electric resistance of the gap is in a semi-unstable condition. A small variation in the physical condition of the surfaces of adjacent filings in the gap is destined to produce large changes in electrical resistance. From this point of view the coherer is a sensitive conductor in electric instability, and operates by virtue of the changes in electric condition consequent on the passage of electric impulses. The new instrument may be described as a magnetically unstable magnetic circuit, in which small changes of magnetizing force, effected by the influence of received electric impulses, can produce a considerable change in magnetic flux. The permeability curve is artificially steepened in the iron subjected to the magnetizing influence of the received electric waves. Henry showed that electric wireless impulses, traversing small solenoids, were capable of magnetizing steel needles acting as cores, and the new apparatus described is a development of that principle. A special form of induction coil has its primary winding in circuit with the receiving vertical antenna. The secondary winding is in circuit with a telephone. The iron-wire core is subjected to slow cyclic variations of magnetic intensity, but rotating a permanent magnet in the neighborhood of one extremity. During the descent and ascent of the cycle HB curve of the hysteresis loop, and particularly during ascent, the iron is in a critical or unstable magnetic condition, such that a small magnetizing impulse in the primary winding, due to the electrically-received impulse, will develop a relatively large secondary induced current through the telephone.

In order to avoid the presence of insensitive intervals occurring cyclically at the points of the hysteresis loop, the plan has been adopted of making the core in the form of an endless band of iron wires threading through the induction coil, and moving this band steadily past fixed magnets, by clockwork, in such a manner as to bring the part of the band within the coil into the unstable magnetic condition. The iron core of the coil is thus constantly sensitive, and has its youthful sensitiveness perpetually renewed by clockwork. No decohering mechanism is needed, and the speed of operation between the Poldhu (Cornwall) and Poole (Isle of Wight) stations, using this apparatus, is described as being 30 words a minute. Curiously enough, Gramme essayed many years ago to develop a commercial form of continuous-current dynamos, consisting of fixed coils of insulated wire through which an endless band of iron was steadily moved by power. The band was subjected to magnetizing forces during its cyclic path in such a way that the hysteretically varying magnetic flux might constantly cut the coils. Only a feeble e. m. f. was, however, in this way obtainable.

It transpired in the course of the lecture that, from long-distance observations conducted on the Atlantic, signals which could be read at a distance of 2,000 miles from Poldhu at night, could only be read at 700 miles from Poldhu by day. The enormous difference of range was attributed to the influence of solar light upon the transmitting radiator, affecting its discharge. Here lies a field for investigation that should produce a rich harvest of interest.

A METHOD OF MEASURING SMALL INDUCTANCES.

A convenient method of measuring inductances, within a certain range, is described by Mr. W. M. Varley in a recent technical periodical. He employs the Braun tube, which deserves to be called the Braun galvanometer, owing to the number of galvanometric uses to which it is already applied. The Braun galvanometer has its exciting electromagnets in circuit with a Leyden jar, and with the coil whose inductance is to be measured. The Leyden jar is charged to constant e. m. f. by an induction coil excited from a constant-potential alternating-current circuit. The Leyden jar discharges at rapidly recurring intervals through the inductance coil, and the Braun galvanometer, producing on the fluorescent screen of the latter an observed deflection. Substituting a coil of known inductance for the coil of tested inductance, the discharging current deflections permit the tested inductance to be evaluated. The principal limitation to the use of the method lies in the constant inductance of the coils in the Braun galvanometer itself. The inductance to be measured must not bear too small a ratio to this constant inductance. Consequently, the lower the inductance of the Braun galvanometer, or the more sensitive it can be made, the smaller become the inductances which can be measured in this manner. From one millihenry to one henry is described as the effective range of the instrument.

REPORT OF THE STANDARDIZING COMMITTEE OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The report of this committee adopted by the Institute at the recent convention, embodies the work of the committee in extension and amendment of its previous report of 1899. Several important additions have made their appearance in the new report. One of these is the section relating to Luminous Sources. The Heffner lamp, under Reichsanstalt standard conditions, is advocated as the standard of reference, and rated at 0.88 British candle for the expression of horizontal intensities in the ordinary commercial unit. The flux of light emitted by a luminous source is duly defined in lumens. The efficiency of an incandescent lamp is defind in terms of its lumens per watt at terminals; while its consumption per horizontal candle-power is defined in watts per candle in accordance with existing usage. Following these recommendations, the watts per candle of an incandescent lamp may be retained under the correct title of consumption; while the efficiency of a lamp will call for a new rating, involving either a measurement of the total flux of light, or the spherical candle-power of the lamp.

The temperature coefficient of copper is also recommended as corresponding to a straight-line law of 0.42 per cent. per degree centigrade, based on copper at zero centigrade. The commercial rating of a railway motor is conventionally defined as the horse-power output, giving 75° C. temperature rise after one hour's continuous operation under standard conditions. But since such a rating is merely for the purposes of classification, the real capacity of railway motors is referred to their temperature elevation under carefully specified conditions, comprising load, speed, stops, acceleration, etc. An important section is devoted to insulation, which occupies nearly two pages. Only a few lines are given to ohmic insulation, the sole meaning usually attached to the term a few years ago. All the remainder refers to volt resistance or dielectric strength. Above 20 kilovolts, rated terminal voltage, the testing voltage is given as 50 per cent. in excess. Below 20 kilovolts the ratio of testing to rated voltage is more severe. Low-pressure apparatus generally is tested at 1,000 volts. The rating of fuses and circuit breakers is

made the normal working current which they can continuously carry, but the strength of current at which they open is also recommended for separate specification. Consequently a ten-ampere fuse would be a fuse which will steadily carry ten amperes. Such a fuse should, however, be rated as a ten-ampere fuse, melting at, say, fifteen amperes.

Standard circuit voltages up to 60 kilovolts now receive recognition for the first time. Standard voltages and frequencies for dynamos and motors are recommended as suitable for various classes of service, and the report will do good work if it aids in maintaining uniformity in the demand for these classes of apparatus. There can be no doubt that, within reasonable limits, the standardization of electric machines, and the selection of a standard size by an engineer, not only enables him to buy that size considerably cheaper than if he had a special size built; but also enables other purchasers to buy that size, or even other sizes, cheaper by the reduction in the cost of production thereby involved. In other words, when an engineer orders a special type of machine in contradistinction to a standard type, he not only has to pay more for that machine, by reason of the extra labor involved in its construction, but he also tends to raise the cost of all other sizes for other purchasers by raising the general average cost of production. It is for this reason in particular that the work of the Standardization Committee of the A. I. E. E. is so important to the industry.

THE NEW NIAGARA PLANT.

One of the most notable papers at the recent Institute meeting was Mr. Buck's most interesting description of the new Niagara power house and its equipment, one portion of which we reprint in this issue. In some very important respects it marks a great advance over the pioneer station, and it makes, too, a notable industrial success. To-day, after the lapse of nearly ten years, one can look back upon the initiation of the Niagara enterprise with something of judicial perspective and measure methods by results. In one very important particular the issue of the Niagara enterprise has justified the wise foresight of its projectors. It was the original purpose to build up at the great cataract an industrial city of the first order of importance, drawing to that spot by the invincible magnetism of cheap power the large power consuming industries. To this end the territory above the Falls was secured and the huge and enormously expensive tunnel was constructed. The erection of this new power house is the final answer to criticism directed at this policy. The fundamental plan called for an industrial city, and an industrial city has risen from the earth. The Niagara plant was not primarily intended to be, has not been, is not, perhaps never will be, fundamentally a transmission plant, but a mammoth central station for power distribution. Half a dozen plants for trivial capacity have done more to advance the art of electrical power transmission, but in its own field Niagara stands unique. The uprising of the city about it is due, of course, primarily to the power plant, but in scarcely less degree to the wonderfully favorable situation as a shipping point for general distribution over the country. We note this lest the unwise should imagine that great industries inevitably cluster around cheap power. We could mention numerous localities in which the enterprise would have been a complete and dismal failure, but the vicinity of Buffalo is almost the most advantageous point in the country in its freight facilities, which are fully as important to cheap manufacture as is cheap power. Even at Niagara it is to be remarked that most of the industries thus far developed are those requiring exceptionally large amounts of power for the area of the works.

In the equipment of the new power house there is general improvement in the apparatus and its arrangement, but in less degree than might have been expected. The great dynamos of the old station were, considering the limitations imposed upon them, most admirable machines. The policy followed in the early work at Niagara was a curious mixture of daring and timidity. At the very start a colossal handicap was imposed in compelling the electrical equipment to be subordinate to the hydraulic equipment. It forced the electrical designs into unusually close quarters, and the excellent results are wholly to be credited to the skill and good judgment of the contractors. The faults of the plant are due to bad advice, happily tempered by good execution. It has always been a matter of wonder to us that it was necessary to go abroad for the turbine designs, even to so eminent a firm as furnished them, and it is doubly strange that the same policy should be followed now. The new generators are to be of the same capacity, voltage, speed and electrical character as the old ones, and also of the same low frequency. The hydraulic efficiency, due to the use of draft tubes, is raised enough to allow an extra 5,000-hp unit. Here is an example of the timidity to which we refer, for the draft tubes were in use in every American saw mill when the first plant was installed, and their omission is small credit to the hydraulic engineering of that installation. The retention of the old voltage and frequency was, perhaps, wise in view of the local utilization of most of the power, and two-phase dynamos will do the work as well as any others; but larger units would have been preferable if the hydraulic contractors would have stood up to their end of the work, as perhaps they might have. Twenty-one generators for a plant of 100,000 hp is a large number, far larger than seems necessary on the face of the evidence, and larger than would be put in a steam plant of similar capacity at the present time.

A far more important change from the electrical point of view is the improvement in the inherent regulation of the great generators. A regulation of only 30 per cent. was not good, even when the first plant was started, and ought to have been bettered long ago. The reason assigned for the change is, in view of the early history of the plant, rather delectable. If memory serves us aright, the two-phase system was alleged to have been chosen for the initial plant by reason of its superior freedom from unbalancing, which was considered most important in view of the electric lighting which was to be done. In the same breath we were informed that the frequency was put at 25—a periodicity notoriously unsuitable for general electric lighting. It now transpires that the improvement in regulation is rendered necessary by so grave unbalancing as to cause trouble even in motor service. All of which makes it clear enough, as is now perfectly well understood, that any polyphase system is subject to trouble from an unbalanced load, and that bad regulation is an evil first, last and always. We have for years dinned into the ears of our readers this apparently obvious fact, and it is with a real feeling of satisfaction that we gloat over the improved design of the new station. Another original blunder which is at last to be put aside is the weird umbrella design of the first machines, since even at the start there were available governors quite good enough to render the extra flywheel effect needless, and there was not the slightest difficulty in then building internal-pole machines closely similar to those now planned. Of course, the art of design has improved in general, but we think that no electrical engineer worthy the name in 1893 would have adopted the umbrella design unless it had been forced on him by pressure from the hydraulic end of the line. If one is to have a stationary armature, it should be accessible, otherwise it might as well rotate. The final improvement in the new station, and one that has our heartiest approbation, is the introduction of a complete system of feeder protection, and of the latest type of switchboard, which will render the plant singularly safe and easy to operate, even as compared with the old one.

Stanley Transformer Patent Decision.

Judge Colt handed down an important opinion ,July 1, in the Circuit Court of the United States, District of Massachusetts, denying a motion for a preliminary injunction applied for under a recent decision affirming the validity of a certain transformer patent issued to William Stanley, Jr., March 1, 1892, on an application filed August 15, 1888. The decision referred to was rendered in a suit brought against the Saranac Lake Electric Light Company, and its effect was claimed to make the Stanley patent a controlling one in the transformer art.

The court in the Saranac Lake decision laid much stress upon a disclosure in the specifications of the Stanley patent of a method for determining the length of primary wire in a transformer. This disclosure, which in the litigation has been called the "Stanley Rule," is that the proper length of primary coil may be determined by connecting the transformer in circuit with the dynamo with which it is to be used, and then winding on wire until, with the secondary circuit open, the loss indicated by the formula C^2R equals a certain loss of energy. In the original case the court decided that this rule is "A part of the invention disclosed and claimed in the patent—indeed it would seem to be the main object of that invention —and with the patent thus construed the citations from the prior art show neither anticipation nor lack of invention. The whole argument of the defendants on that branch of the case is so interwoven with the postulate that the Stanley rule is to be eliminated from the patent, that when the postulate is not granted the argument becomes wholly unpersuasive."

Judge Colt, in his opinion, said that in the present case it becomes necessary to determine whether the court in its opinion imposed the limitation of the Stanley rule upon the claims of the patent then in litigation. The points made by the parties in the present case are summarized by the court substantially as follows:

The complainant maintains that the court imposed no such limitation upon the Stanley invention; that the court held that the invention was for a transformer, "which is automatically self-regulating as to a secondary pressure," and "not for a rule"; or for "a transformer having such a length of wire on its primary coils as would make it self-regulating"; or for "a transformer having in its primary coils substantially such a length of wire as was described in the specification, and which would effect the result sought, irrespective of the means or methods employed in arriving at the result"; or for a transformer which has "in its primary coils the proper length of wire to make it self-regulating"—all of which means that the Stanley patent was held to cover the transformer described, irrespective of the Stanley rule, by which the length of wire is obtained, although it was incumbent upon Stanley to point out one method by which the proper length of wire was determined. On the other hand, the contention of the defendant is that it is perfectly plain from the decision of the court that the Stanley rule is inherent in the Stanley invention, and that this limitation is imposed upon the claims.

As to the contention of the complainants, that since the Saranac transformer had been enjoined by the court in the Saranac case, it is the duty of the present court to enjoin the defendant unless it is shown that the transformer now in suit differs essentially from the Saranac transformer, Judge Colt decides that this position is not well taken, but that it is the duty of the complainant under its present bill charging infringement to show first, what the Stanley patent covers as defined by the court in the other case, and, second, to show that the transformer now manufactured by the defendant comes within the Stanley invention as exactly defined.

Concerning the contention of the complainants that the Saranac transformer did not embody the Stanley rule, and that consequently the transformer now alleged to infringe comes within the decision in the other case, Judge Colt holds that in view of the opinion of the court it must be presumed that the Saranac transformer contained the Stanley rule. Any other interpretation, he said, would lead to the following conclusions: "On the question of the validity, the Stanley patent is limited by the Stanley rule, while in the question of infringement there is no such limitation; in other words, a transformer may be outside of the monopoly secured by the patent and still infringe the patent." Judge Colt says there is nothing in the language of the opinion of the Circuit Court of Appeals or of the Circuit Court in the Saranac case which would justify him in holding that any such illogical and inconsistent conclusion was reached. After the Appellate Court in the other case had determined that the Stanley invention for the most part resided in the Stanley rule and that the "rule" must be incorporated into the claims; and after the court said on a petition for re-hearing that, "As to infringement" it "did not deem it necessary to add anything to the opinion below," it is manifest that the Appellate Court did not understand from the opinion of the lower court that the Stanley rule was eliminated from the Saranac transformer.

Judge Colt held that the Stanley "rule" is the main contribution made to the art, and that it constitutes the principal and most essential part of the invention covered by his patent. He disagreed with the complainant's counsel that the court in the former case found the Stanley invention to reside "in a certain length of primary winding," and their argument on this point he considered to be plainly in conflict with the invention as defined by the court. He could find in the opinion nothing to warrant the contention that it was Stanley's discovery of the proper length of wire in the primary which consituted his invention; or that the invention is for a transformer having a proper length of wire; or that the Stanley rule is no part of the invention claimed, but only one method of determining the length of the wire. On the contrary, the court expressly declared that the Stanley rule is the main part of the invention disclosed in the claim. The motion for a preliminary injunction was denied. The parties in the litigation were the Westinghouse Electric and Manufacturing Company and the Stanley Electric Manufacturing Company.

Meetings of Electrical Contractors.

As already noted in these columns, the National Electrical Contractors' Association of the United States will hold its annual meeting next week at the Hotel Walton, Philadelphia, Pa. The board of directors will meet at the hall of the Franklin Institute at 9 A. M., July 16. The first delegates' meeting will be called to order in the same hall at 1:30 P. M., on that date. In the afternoon a special boat will take the delegates and invited guests along the river front to Cramp's Shipyard and to League Island. A dinner for the delegates will be given at 7 P. M. On July 17th the delegates' meeting will be called to order at 2 P. M., on the Steel Pier, Atlantic City, N. J. A special train will leave Philadelphia for Atlantic City at 9 A. M., of July 17. The entertainment committee will provide transportation to and from Atlantic City for the delegates. The convention will adjourn on the afternoon of July 17. Mr. Alex Henderson, master of transportation, announces a special train over the Jersey Central, from New York to Philadelphia, leaving on July 16th, at 9:30 A. M.

The semi-annual meeting of the Electrical Contractors' Association of New York will be held at Albany on July 15th, under the auspices of the Eastern New York Electrical Contractors' Association. The headquarters of the association will be at the Hotel Ten Eyck. The directors' meeting will be held at 9 o'clock A. M., July 15th, and will be immediately followed by the meeting of the delegates. At 12 o'clock a trolley ride will be taken to Schenectady and the works of the General Electric Company, and a lunch will be served at that place. At 8 P. M. the delegates will leave Albany by the steamboat "Adirondack," for the trip to New York.

Arrangements have been made to serve a banquet on the boat after leaving Albany. Mr. Charles L. Eidlitz, president of the National Association, will act as toastmaster. It is expected that the directors of the National Association will be among the guests at the State meeting.

A German Commission.

The Imperial German Post Office has just appointed a commission to go to the United States and study American postal, telegraphic and telephone systems. Special attention will be given to the tubular mail service. Germany at present is using only small tubes for individual letters, and contemplates introducing the American system of transmission in bulk by mail to and from the branches of the central post office. The commissioners are Post Councillors Wernecke, of Leipzig, and Braun, of Hamburg. They will be accompanied by a telegraphic engineer and another engineer of Berlin.

The Concord, N. H., Water Power Plant.

FROM the foot of the Franconia Mountains, down through the heart of New Hampshire, past the great Lake Winnipiseogee, the Merrimac River flows two hundred miles to the ocean. Between its sources, more than 2,000 feet above tidewater, and the Atlantic, this river drains an area of 4,553 square miles. At Lawrence, about twenty miles from the ocean, the average yearly discharge of water by this stream is about 6,464 cubic feet per second. Nearly half-way from mountains to seashore, along the course of the river and equidistant between the short coast line of New Hampshire and the Connecticut River, Concord, the capital city, is built on the high west bank of the Merrimac. Compared with Manchester, the industrial center of the State, some seventeen miles down stream, Concord is not a great manufacturing city. Its fame rests rather on its residential attractions, its institutions of learning, its fine public buildings, including the time-worn State House, and on its political importance as the point where legislative functions are exercised.

According to the Federal census of 1900, the population of Concord was only 19,632 persons. In spite of all these facts, tending to lines of development other than technical, the capital city is the site of one of the best examples to be found anywhere of electrical supply operated almost exclusively by transmitted water-power. In 1892 the load of electric lamps in Concord was transferred to a water-power station on the Merrimac by means of a three-phase transmission. This is believed to be one of the earliest, if not the first instance, in which the entire commercial service of a city electric system was derived from a three-phase water-power plant. Prior to the date just mentioned electrical supply in Concord had been carried on from a steam-driven station by the local gas company. About that time the interests of the gas company in the electric lighting system were transferred to the Concord Electric Company, the present owners. At Sewall's Falls, in the Merrimac River, about four miles from the State House in Concord, and nearly north, a stone and timber dam was built in 1892. This dam is about 500 feet long, and gives a fall of sixteen feet for the entire flow of the river. At the water-power thus provided the three-phase generating station of the Concord Electric Company was erected in the year last named. The minimum capacity of this water-power in dry seasons is estimated at 2,500 horse-power, and there has always been sufficient water to operate the electric plant. Some trouble with anchor ice has made the use of steam necessary at times in early winter before the river was frozen over, but this has been of short duration.

In 1901 new water-wheels were installed at this electric station, and the three-phase generators of 1892 were replaced by others of later pattern. The new wheels comprise five pairs of horizontal turbines, each pair being 36 inches in diameter and rated at 300 horse-power when operating at 140 revolutions per minute under a head of fifteen feet of water. Each pair of wheels is regulated in speed by a Lombard governor. These wheels were furnished by the Stilwell-Bierce & Smith-Vaile Company.

A three-phase, 60-cycle alternating generator of the revolving magnet type, with capacity of 200 kilowatts at 2,600 volts, is belted to each of the five pairs of turbine wheels just mentioned. The combined capacity of these generators is thus 1,000 kilowatts. All five of these machines were made by the General Electric Company. Current for the magnet windings of the three-phase generators is supplied from one 30-kilowatt, 230-volt exciter, motor driven, and from two bipolar exciters of 15 kilowatts each, driven by belts from the main dynamos. One of the old three-phase generators, displaced by those just described, is now used as a motor of 150-horse-power capacity to drive two direct-current arc dynamos, with capacity of 75 lamps of 1,200 candle-power each at the water-power station. The switchboard at this station is built of wood on the skeleton pattern, and contains five panels for the main generator, one for the exciters, and four for feeders. There is also a board for the arc dynamos.

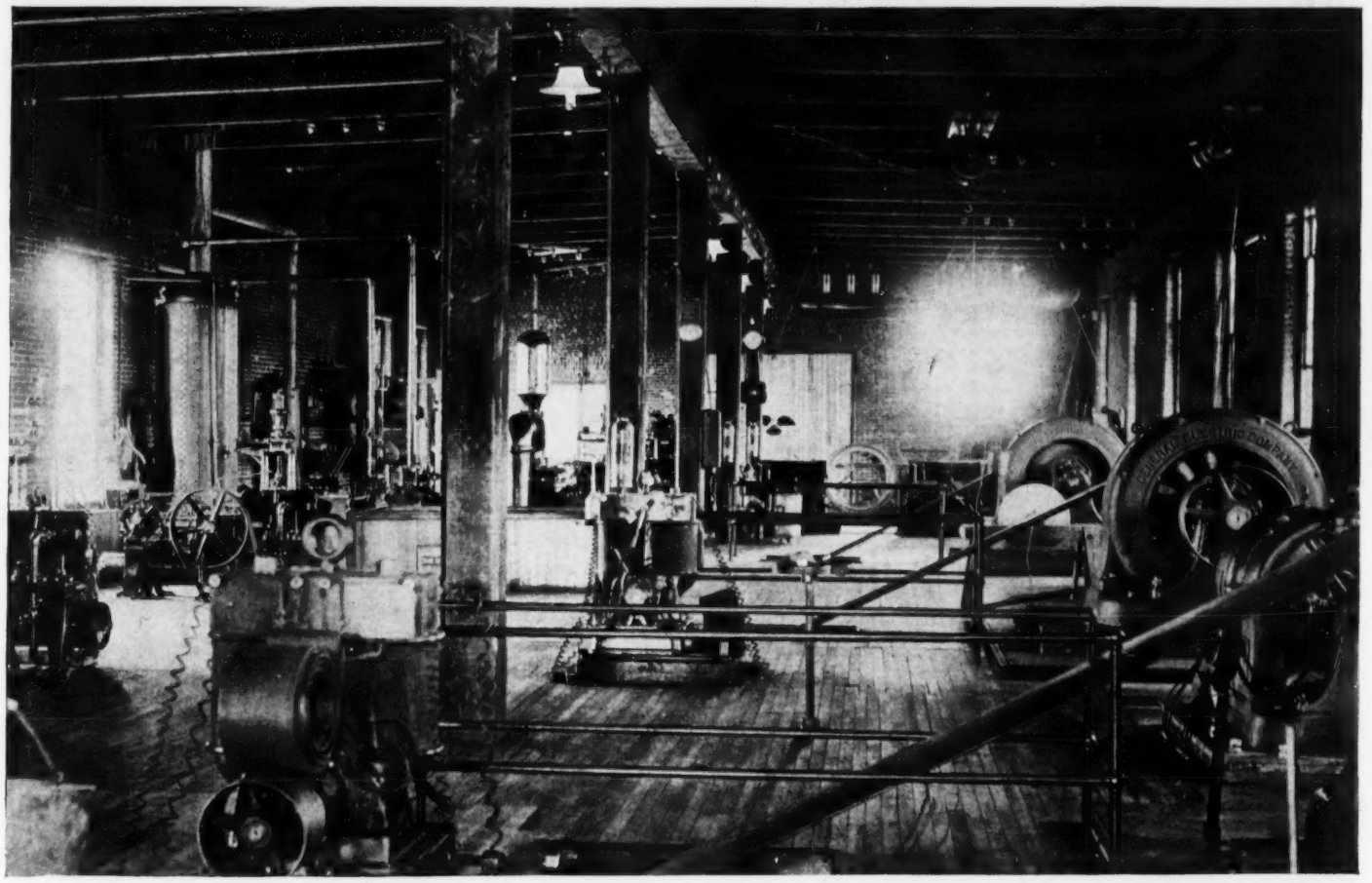


FIG. 1.—INTERIOR VIEW OF CONCORD WATER POWER PLANT.

The five main generators all deliver three-phase current at 60 cycles and 2,500 volts to the switchboard just mentioned. From this board energy goes directly to the motor that drives the two arc dynamos. Three No. 6 wires conduct energy at 2,500 volts from the board to West Concord, a village two miles distant. Three No. 00 insulated wires pass from the water-power plant to the sub-station near the business center of Concord, over a pole line about 4.5 miles long, at the pressure of 2,500 volts. Another circuit of three No. 6 bare wires on this same pole line delivers energy at 10,000 volts in the sub-station. This energy is derived from three transformers of 100 kilowatts each that are located in the water-power plant and fed from the switchboard at 2,500 volts. The ratio of transformation

is thus four to one, and the transformers are of the air-blast type. At the sub-station the No. 6 wires just mentioned terminate in three transformers of 100 kilowatts each, that reduce the pressure from 10,000 to 2,500 volts for local distribution. Three transformers, of 150 kilowatts each, located at the main generating plant, take 2,500-volt current from the switchboard and deliver energy at 10,000 volts to three No. 6 bare wires that pass over the pole line previously mentioned and on to the shops of the Boston & Maine Railway, distant 5.5 miles from the water-power. At these shops the three No. 6 wires feed two transformers of 200 kilowatts capacity each, that change the energy from three-phase, 10,000 volts to two-phase at 440 volts. From the foregoing it may be seen that the combined capacity of the six 10,000-volt transformers at the water-power plant is 750 kilowatts, or three-fourths of the total capacity of the main generators there. All 10,000-volt transformers are cooled by air blast. Besides the three circuits already mentioned, two pairs of No. 6 wires from the arc dynamos and a set of No. 6 pressure wires pass from the main station to Concord over the pole line mentioned. These wires cross the Merrimac River by a span seven hundred feet long immediately on leaving the generating station.

The two arc circuits do not enter the sub-station, and are employed in the supply of arc street lamps about Concord. Energy delivered by the three No. 00 wires at a pressure of 2,500 volts in the sub-station is distributed from that point to the local city circuits at the same voltage. Energy derived from the three transformers of 100 kilowatts each at the sub-station is fed into the same circuits that receive current from the three 00 wires. After these 00 wires

FIG. 2.—EXTERIOR OF PLANT, SHOWING WATER GATES.

had been in use some time, the percentage of loss in them grew larger than was desirable; so the 100-kilowatt, 10,000-volt transformers, three at the water-power and three at the sub-station, were installed and connected by the circuit of No. 6 wires, in order to avoid the use of much heavier conductors.

Owing to the troubles with anchor ice at the water-power plant, a steam-power equipment was installed at the sub-station in 1898. The boiler at this sub-station is of the water-tube type, with three drums, rated at 600 horse-power, and was built by the Babcock & Wilcox Company. A Buckeye engine, cross-compound and rated at 500 horse-power on 200 revolutions per minute, is belted to a 450-kilowatt, three-phase, 60-cycle, 2,500-volt generator, made by the General Electric Company. This generator operates at a speed of 257 revolutions per minute, and has 28 poles. When this plant at the sub-station is in use, it delivers energy to the same distribution circuits that receive current from the water-power plant. A 10-kilowatt exciter, belt-driven, is employed with the generator at the sub-station.

All of the commercial electric service in Concord, except that at the Boston & Maine shops, is carried out with the three-phase, 60-cycle current from the sub-station. The 2,500-volt circuits extend generally over the city, and in the business center a closed loop of about one mile total length is run, to avoid the frequent use of small transformers. This loop is composed of three primary and three secondary wires, the latter having a pressure difference between them of 110 volts. From this secondary loop service wires are carried directly into the premises of consumers. Between the primary and secondary wires of this loop transformers are connected at moderate intervals to keep the necessary size of the secondary wires within limits. Twelve banks of transformers are thus connected to the service loop, and have a combined capacity of 262 kilowatts.

The transformers used in the distribution of commercial service are as follows:

Number.	*Watt capacity each.*	*Number.*	*Watt capacity each.*
9	600	7	4,500
2	900	7	5,000
6	1,000	3	6,000
4	1,500	42	7,500
40	2,500	1	10,000
4	4,000	15	15,000
		3	18,000

The total of these numbers is 143 transformers, with a combined capacity of 823.7 kilowatts. In this list the small percentage of total capacity represented in the smaller sizes of transformers is especially notable, and should contribute to high efficiency of operation. No doubt the large average capacity of transformers is due in part to the use of the service loop above mentioned. Adding the 400 kilowatts of transformer capacity at the Boston and Maine shops to the 823.7 kilowatts just found for other service transformers gives a total of 1223.7 kilowatts, or 22 per cent. more than the combined capacity of the main generators at the water-power plant. Of course, there never comes a time when all of these transformers are working at full capacity, especially as those at the Boston and Maine shops supply energy mostly to motors that operate during the hours of daylight.

Most of the commercial service from the Concord electric system is supplied through Thomson recording wattmeters, of which the following numbers and sizes are in use, all on 110-volt circuits:

Ampere Capacity.	*Number.*	*Ampere Capacity.*	*Number.*
5	111	75	3
10	100	100	13
15	76	150	6
25	63	200	1
50	29	300	1
60	2		

The total number of these 110-volt meters is 408, and there are in addition two recording meters at the Boston and Maine shops, each meter having a capacity of 500 amperes at 450 volts.

All clases of commercial service, arc lamps, incandescent lamps and motors are from the same set of distributing lines in the Concord system. Commercial arc lamps are all of the enclosed type, taking about 6.5 amperes, and are connected singly to the 110-volt lines. At present 150 of these lamps are in use. About 10,000 incandescent lamps, mostly of 16 candle-power, are connected to the system. Street arcs to the number of 129 of 1,200 candle-power each are in use for public lighting in Concord. These arc street lamps are operated directly from the water-power plant by the two arc dynamos there located. It is the intention during the present year to substitute enclosed arcs taking 6.5 amperes at 80 volts for the open type of street lamps now in use.

Though Concord is not pre-eminently a city of manufactures, the motor business of the electrical supply system is exceptionally large, compared with that in other lines. The total capacity of motors now connected to the company's lines is 1,144 horse-power. All of these motors are of the induction type, and all save those at the Boston and Maine shops are three-phase at 110 volts. The numbers and capacities of these three-phase, 110-volt motors are as follows:

Horse-power.	*Number.*	*Horse-power.*	*Number.*
½	9	10	9
1	16	15	11
2	13	20	2
3	10	25	1
5	18	30	2
7½	1		

The motors last named number 91, and their aggregate capacity amounts to 554 horse-power, giving an average of more than 6 horse-power per motor, which is unusually large for motors in general commercial service. At the Boston and Maine shops, where the two transformers of 200 kilowatts each change three-phase energy at 10,000 volts to two-phase energy at 440 volts, only two-phase motors are in use. The numbers and capacities of these motors are as follows:

Horse-power.	*Number.*	*Horse-power.*	*Number.*
10	1	25	2
15	6	30	6
20	3	40	2
		100	1

These 21 motors have a combined capacity of 590 horse-power, which, added to that of motors on general commercial circuits, gives the total of 1,144 horse-power. Allowing an average efficiency of 74.6 per cent. for all of these motors in actual use, their combined

capacity at full load to draw energy from the lines is 1,144 kilowatts. At 56 watts per lamp, the 10,000 connected incandescent lamps represent a capacity for consumption of 560 kilowatts. The 129 open arcs on direct-current lines, rated at 1,200 candle-power each, require in operation 38.7 kilowatts, on the basis of 300 watts each, and the 150 enclosed arcs, each taking 6.5 amperes at 110 volts, absorb 107.25 kilowatts. The energy rate for all connected lamps is thus 706 kilowatts, and for lamps and motors combined, 1,850 kilowatts. Of this total, the capacity of connected motors amounts to the exceptionally large percentage of 61. The capacity of the connected load exceeds that of the main generators at the water-power plant by 85 per cent.

Records of the station meters show that the week-day output of the Concord system averages about 6,800 kilowatt-hours. This corresponds to an average load of 283 kilowatts during the 24 hours of each day. If the maximum load is three times the average, it amounts to 85 per cent. of the main generator capacity at the water-power.

During 1901 it was necessary to operate the steam plant at the sub-station to a larger extent than common, because of changes in water-wheels and dynamos at the main station. In spite of this fact, the record of the fiscal year ending June 30, 1901, presents the advantages of water-power as a saver of fuel in a strong light. During the year just named about 500 tons of coal were consumed at the sub-station.

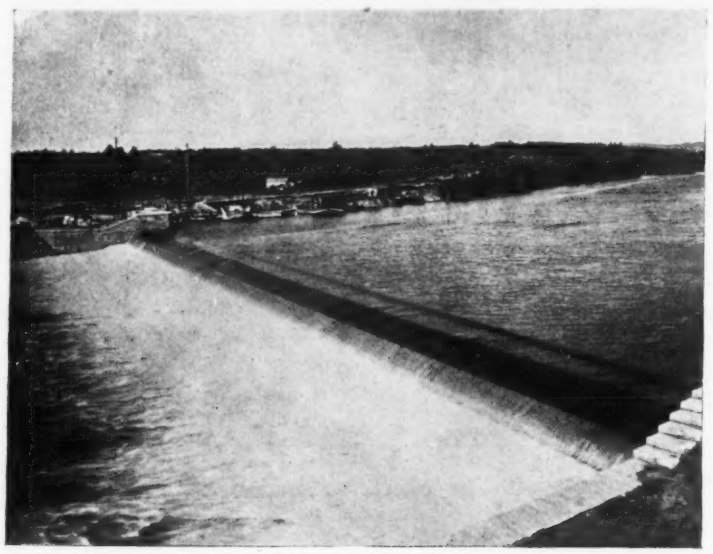


FIG. 3.—DAM AT SEWALL'S FALLS.

Considering only the working days of the year as 310, the coal consumption was 1.61 tons per day on an average. At the moderate rate of six pounds of coal burned per kilowatt-hour of output at the station, the 6,800 kilowatt-hours of daily output would require 20.4 short tons. From these results it appears that the consumption of fuel during the year in question was less than 8 per cent. of what it would have been with a fairly efficient steam station giving the entire output. The difference between this computed daily consumption of coal and that actually burned is 18.8 tons. Good steam coal is worth about $5 per ton in Concord, so that the use of water-power saves approximately $94 per day in the cost of fuel.

The engine at the sub-station is now operated non-condensing because of the cost of water, but it is proposed to move the steam plant to the water-power station at an early date, where condensing water can be had free, and the cost of labor for operation reduced.

The marked success of the Concord Electric Company seems to be due in no small measure to its use of water-power. This view is certainly borne out by the fact that the electric system supplies motors of almost 600 horse-power capacity in the shops of the railway that brings all of the coal used in the city. Further illustration of the advantages of water-power is found in the successful competition of the electric system with the local gas company. The nominal price of gas in Concord is $1.50 per 1,000 cubic feet, but it is believed that large consumers get materially lower rates. This gas is reputed to be of good quality, and the price named is certainly moderate for an inland city as small as Concord. The gas company does not court comparison with the electric system, as its officials declined to give any facts as to their output for use in this article. The success of the Concord electric system seems to be due in large measure to the efforts of its efficient superintendent, Mr. George B. Lauder, to whom thanks for these facts are due.

Safety in Elevators.

BY GUSTAF RENNERFELT.

Once in a while we still hear about accidents in elevator service. The exact cause is seldom told, and we are simply informed that "the car was equipped with every known safety device—a rigid investigation as to the cause will be made." The frequency of the accidents would seem to indicate that there is something wrong with some safety device, or that some one may be lacking.

In my humble opinion there is in high-speed electric elevators at least one safety device still lacking, and I have reason to believe that this was the direct cause of an accident not very long ago. The safety device which I refer to, is one which should prevent the elevator from attaining excessive speed on "run away" when the motor happens to be driven as generator by the load.

If the motor were a pure shunt motor with no resistance in its armature circuit, this danger would not exist, since its speed, and thus the speed of the car, could not be raised beyond a certain limit. For good reasons, however, the motor of a high-speed elevator is not of such a kind. It is generally a compound-wound motor, and when driven as generator by the load, it will turn into a differentially-wound dynamo with constant torque. Such an arrangement has no fixed speed limit, and cannot exert any checking action on the car, which thus will increase its speed.

The proper remedy to apply for this excessive speed is evidently to remove the cause and change the differentially-wound dynamo to a shunt-wound one; that is, to short-circuit the series winding. This can be done by an apparatus, the action of which depends on the speed of the counter e.m.f. of the motor, so that the desired short-circuit is established when the said e.m.f. exceeds the line voltage by a small amount, and is again removed when the e.m.f. drops below the line voltage. No sparking at contacts would occur in such an apparatus, since it would operate just when the current changed direction, and its strength was almost nil.

As far as I can recollect, there has never in your columns been mentioned any apparatus for such purpose, and I therefore conclude that it has not been applied to elevator service. I believe, however, it has been suggested to establish the short circuit by means of a magnet adjusted so as to operate when the counter e.m.f. of the motor reaches a certain value, in a manner similar to the magnets now used for automatically operating the starting resistance. This, however, would not accomplish the desired result, because the line voltage is not constant, and if the magnet were adjusted to the normal voltage it would act too soon if the line voltage were higher, and it would not act at all, if the line voltage were lower than the normal.

The chances of running away on account of the motor being driven as a differentially-wound dynamo, are greater with elevators operated at high speed than at low speed; and with an over-balanced car, the excessive speed is liable to occur when the car is travelling in either direction—up or down. The question of safety in elevators is indeed one that concerns most all of us, and it would no doubt interest many readers of your paper if those informed on the subject would point out what means are now provided in electric elevators to guard against the danger above referred to.

Important Power Transmission Around Grand Rapids.

Along with the consolidation of all the electric light and power work of Grand Rapids, Mich., under the control of one company, the Grand Rapids Edison Company, some interesting developments in the way of long-distance transmission into Grand Rapids from water power on the Muskegon River are promised. The Newaygo Water Power Company has water rights on the Muskegon River, above the town of Newaygo several miles, and it is proposed to put in a plant with a capacity of about 7,000 hp to generate current for transmission to Grand Rapids and for use on the Grand Rapids Edison Company's system. Plans for a substation in Grand Rapids are being drawn up, which will put a storage battery plant in the basement and rotary converters on the first floor of a building adjoining the present steam plant of the company, on the east side of the Grand River, not far from the center of the business district. The transmission line from the plant on the Muskegon River will be about 36 miles long, and the transmission voltage in the light of present practice is not likely to be less than 40,000 volts. A storage battery of 1,000 ampere-hour capacity, at a 1-hour rate, will soon be put on the three-wire, direct-current network in Grand Rapids.

Electrode Terminology.

BY ALBERT M. LEWERS.

IT would be interesting to know upon what grounds the common use of the terms "positive" and "negative," as applied to the electrodes or active materials of secondary batteries, is based. Almost without exception American writers designate the peroxide electrode as the "positive" and the spongy lead electrode as the "negative." Theoretically considered, this appears to be an improper designation of the electrodes, and especially of the active materials when considered by themselves, since peroxide of lead is electro-negative to spongy lead. The only reason I have ever seen stated as to why the peroxide electrode should be called positive and the lead negative, is given in the introduction to "The Storage Battery," Treadwell, wherein he quotes the London *Electrician* as stating that "the positive plate of a secondary battery is properly so-called, because it is *plum colored* and peroxidized, while the negative plate is of a neutral color and non-oxidized." The force of this reasoning is difficult to appreciate.

The confusion that has arisen in the terminology of the electrodes of secondary batteries is recognized by most writers, but they usually adopt what seems to be an incorrect nomenclature, giving as their sole reason that it is the one usually employed. For instance, Prof. Marsh, in his recent excellent article on "The Possibilities for a Light Weight Storage Battery," (ELECTRICAL WORLD AND ENGINEER, June 7, 1902), refers to the confusion that has arisen in the use of the terms "negative" and "positive," and then proceeds to apply the term "positive" to the more electro-negative materials. A manufacturer of storage batteries may be justified in designating the peroxide plate as the "positive," as its terminal or pole is positive and is so marked. In order to avoid confusing the users of the batteries, who, perhaps, may not know that the positive terminal is on the negative electrode, and *vice versa,* and who are concerned only with the external circuit, the makers of batteries designate the electrodes by the signs of their terminals. This may be all right from a commercial standpoint, but affords no good reason for the same loose use of the terms in the theoretical consideration of secondary batteries.

Faraday, the originator of the term "electrode," defines the electrodes as follows: "The anode is that surface at which the electric current, according to our present expression, enters; it is the negative extremity of the decomposing body; it is where oxygen, chlorine, acids, etc., are evolved, and it is against or opposite the positive electrode. The cathode is that surface at which the current leaves the decomposing body, and is its positive extremity; the combustible bodies, metals, alkalies and bases are evolved there, and it is in contact with the negative electrode (Experimental Researches in Electricity." Faraday. Vol. I. Art. 663).

Following this definition, the electrode at which the current leaves the electrolyte and the one at which metals or bases appear, at which reduction takes place, is the *negative* electrode. In those batteries having oxide depolarizing material, such as the oxides of lead, nickel, silver, copper, etc., the current leaves the electrolyte at the electrode carrying the oxide, which is reduced during the action of the battery, and this electrode, according to Faraday, is the negative and not the positive.

In considering primary batteries, the soluble or oxidizable electrode, for instance, zinc, is commonly referred to as the positive and the other electrode, for instance copper, is called the negative. Why then, when considering secondary batteries, which are but reversible primaries, are the terms used in the opposite sense? In a primary battery having one electrode of copper oxide and the other of zinc, the copper oxide, is called the negative and the zinc the positive electrode; but if the battery is a secondary and has one electrode of lead peroxide and the other of lead, or it may be of zinc, then for some unknown reason the lead peroxide is to be called "positive," and the lead or zinc "negative," though the direction of internal current flow is towards the oxide in each case. It does not seem consistent to call an electrode made of chemically formed peroxide of lead "negative" when used as the depolarizer of a primary cell, and to call an electrode of the same material "positive" when used in a secondary cell. If it is negative in one case, it is in the other. The fact that the peroxide of this secondary cell is formed by passing a current to an anode of a lower oxide or of metallic lead, and that it is capable of regeneration by "charging," should have no bearing upon its sign. It does not seem proper to consider the cell from the standpoint of charging in determining the signs of the electrodes, since during charging it is hardly a battery, as it is not generating energy, but rather is an ordinary electrolytic cell, and the electrodes may be termed anode and cathode, definite terms, in the use of which there is fortunately no confusion.

The confusion in the use of "positive" and "negative" has undoubtedly arisen from the fact that the polarity of the terminal or pole of an electrode is the opposite of that of the electrode itself. Or stated differently, the electrodes when considered from the standpoint of the external circuit have inverse signs from what they have when considered with respect to the internal circuit. As it is usual to take into account only the internal circuit in the theoretical consideration of other forms of electrolytic cells, no reason is apparent why the external circuit instead of the internal circuit should determine the polarity in considering secondary batteries.

As there is apparently some objection to designating the polarity with respect to the internal circuit, especially when viewed from the manufacturer's or user's standpoint, the terms *positive-pole electrode* and *negative-pole electrode* might be used to indicate the peroxide and spongy lead electrodes, respectively, the word "pole" meaning terminal. This terminology, while somewhat cumbersome, is correct, whether referring to the electrodes during charging or during discharging, or with respect to the internal or the external circuit, and is definite and accurate from a commercial standpoint, as well as from that of the electro-chemist. Some writers have adopted the terms "peroxide plate" and "spongy lead plate," notably Fitzgerald in "The Lead Storage Battery," referring to the usual nomenclature as an absurdity; and also Schoop in "Electrische Accumulatoren." These terms, while having the merit of being definite and accurate, are applicable to lead-peroxide of lead batteries only. The terms *positive-pole* and *negative-pole* are of general applicability to all forms of secondary or primary cells, and are the terms now in use in the U. S. Patent Office, besides being in common use in Germany.

But whatever terms may eventually be selected, it is without question very desirable that some definite and accurate system of designating the electrodes of secondary batteries be adopted and an end put to the present annoying confusion in the use of "positive" and "negative."

The Hertzian Theory.

BY S. M. KINTNER.

The article by Mr. Edward P. Thompson on "Long-Distance Wireless Telegraphy and Hertzian Waves," published in the ELECTRICAL WORLD AND ENGINEER, of June 14th, was exceedingly timely. It seems to me that it is time the Hertzian wave idea, as far as the rectilinear propagation is concerned, was abandoned. In a note to this journal about a year ago I called attention to this very point and suggested the theory, proposed by several others previously, of sliding waves over the earth's surface as the best explanation of the transmission of these ether disturbances over great distances. It may be of interest to some to set forth a few of the points tending to show the strength of this theory.

This can best be done by comparing the three theories most commonly advanced, i. e., "Hertzian Waves Rectilinear Propagation," "Sliding Waves over Conducting Surfaces," and "Oscillatory Currents Transmitted Through the Earth as a Conductor," in connection with some of the known facts of wireless telegraphic communication.

For long-distance work all three theories will do fairly well, if allowance is made for the possible reflection of the rectilinear propagation from conducting media above the surface of the earth, such as clouds and rarified air; but if obstacles such as a city intervene and the stations are moved nearer together, it is well known that signals are sent and received only with great difficulty. It seems to me this failure is best explained by the slding wave theory, as the other two should work as well, or nearly as well, under these conditions, as signaling over land with no obstructions like cities or forests intervening. The reflections should be as strong in one case as the other, and while direct radiations would be cut off by the obstacles, so it would be for long-distance work, due to curvature of the earth, and yet more trouble is experienced with cross-city signaling than with the long-distance work over water. The "Oscillatory Currents" would depend upon conductivity, inductivity and capacity, and the intervention of a city would, it seems to me, change

that but very little, and so good results should be gotten in city work according to that view. The sliding waves moving along and above the surface of the earth as concentric circles from the disturbing center, would come in direct contact with the city buildings, lightning rods and all vertical conductors, and thus be robbed of their energy and these obstructions would cast what might be called electromagnetic shadows. Any apparatus intended to detect the presence of any sliding waves, as in wireless telegraphy, located in this shadow would be more or less completely screened and consequently would fail to respond.

If experiment should show that a tall wire is not necessary and that a wire but a few inches in height, having the same electrical properties as a tall one, works equally well, then one could drop all the theories other than the oscillatory current. As I know of no such experiment on a large scale, having been performed successfully, I am still inclined to stick to the "sliding wave" idea.

Marconi on Wireless Telegraphy—II.

(*Concluded.*)

THE subject was then taken up of the detector of the electric waves. In all wireless telegraph apparatus used up to quite a recent date, a detector, now called a coherer, has been employed. This detector is based on discoveries and observations made by S. A. Varley, Prof. Hughes, Colzecchi, Onesti, and especially Prof. Branly. Prof. O. J. Lodge has made large use of this apparatus, which he first named" coherer," in the very numerous experiments and studies he has carried out on the effects produced by Hertzian waves.

The form of coherer found most trustworthy and reliable for long-distance work consists of a small glass tube about four centimetres long, into which two metal poles pieces are tightly fitted. They are separated from each other by a small gap which is partly filled with a mixture of nickel and silver filings. Provided such a coherer is properly constructed, and the tapper and relay in good adjustment, it proves to be quite reliable when within the range of the transmitting station.

Experiments with syntonic systems have, however, shown that certain kinds of coherers can be far more advantageously employed than others. One apparently all-important condition is that the resistance of the coherer in its sensitive state or after being tapped should appear to be infinite when measured with an e. m. f. of about 1 volt.

If the tapping does not entirely do away with the conductivity of the filings very poor results are obtained, which can be explained as follows: According to the systems above described, electrical syntony between the transmitter and receiver is dependent on the proper electrical resonance of the various circuits of the transformers used in the receivers. The condenser and secondary of the transformer must not be partially short-circuited by the coherer, otherwise the oscillations cannot mount up or sum up their effect, as is essential in order to produce the difference of potential at the ends of the coherer necessary for breaking down its resistance, but the eelctrical oscillations will leak across the conductive coherer without causing it to record any signal. Of course, the condenser is short-circuited when the filings cohere under the influence of the received oscillations, but in this case the signal is already recorded and the tapper at once restores the coherer to its non-conducting condition, and in this way restores its sensitiveness.

By using coherers containing very fine filings, the necessary condition of non-conductivity when in a sensitive state is obtained. Coherers have lately been tried which will work to a certain extent satisfactorily without the necessity of employing any tapper or decoherer in connection with them. Nearly all are dependent on the use of a carbon microphonic contact or contacts, which possess the curious quality of partially reacquiring spontaneously their high resistance condition after the effect of the electrical oscillations has ceased. This enables one to obtain a far greater speed of reception than is possible by means of a mechanically tapped coherer, the inertia of the relay and tapper, which are used in connection with it, being necessarily sluggish in their action.

In all these self-decohering coherers a telephone which is affected by the variations of the electric current, caused by the changes in conductivity of the coherer is used in place of the recording instrument. It has not yet been found possible to actuate a recording instrument or a relay by means of a self-restoring coherer.

The late Prof. Hughes was the first to experiment with and receive signals on one of these coherers associated with a telephone. His experiments were carried out as early as 1879, and Mr. Marconi expressed regret that this pioneer work of his is not more generally known.

Other self-restoring coherers were proposed by Profs. Tommasina, Popoff and others, but one which has given good results when syntonic effects were not aimed at was designed by the technical personnel of the Italian Navy. Mr. Marconi stated that this coherer, at the request of the Italian government, he tested during numerous experiments. It consists of a glass tube containing plugs of carbon or iron with between them a globule of mercury. Mr. Marconi added that Lieutenant Solari, who brought him this coherer, asked him to call it the "Italian Navy Coherer." Recently, however, a technical paper gave out that a signalman in the Italian navy was the inventor of the improved coherer, and Mr. Marconi says he was at once accused in certain quarters of suppressing the alleged inventor's name. He, therefore, wrote to the Italian Minister of Marine, Admiral Morin, asking him to make an authoritative statement, to which he could refer in the course of this address, of the views of the Italian admiralty on the matter. The head of the Italian navy was good enough to reply by a letter, dated the 4th inst., in which he makes the following statement, translated from the original Italian:

"The coherer has been with good reason baptized with the name of "Italian Navy Coherer," as it must be considered fruit of the work of various individuals in the Royal Navy, and not that of one."

These non-tapped coherers have not been found to be sufficiently reliable for regular or commercial work. They have a way of cohering permanently when subjected to the action of strong electrical waves or atmospheric electrical disturbances, and have also an unpleasant tendency towards suspending action in the middle of a message. The fact that their electrical resistance is low and always varying, when in a sensitive state, causes them to be unsatisfactory, for the reasons already enumerated, when worked in connection with the Marconi system of syntonic wireless telegraphy.

These coherers are, however, useful if employed for temporary tests, in which the complete accuracy of messages is not all-important, and when the attainment of syntonic effects is not aimed at. They are especially useful when using receiving vertical wires supported by kites or balloons, the variations of the height of the wires (and, therefore, of their capacity) caused by the wind making it extremely difficult to obtain good results on a syntonic receiver.

Coherers have long been considered as constituting almost the essential basis of electric space telegraphy, and although many other detectors of electric waves existed, none of them possessed a sensitiveness which even approached that of a coherer, and most of them were also unsuitable for the reception of telegraphic messages.

With a view to producing a receiver which could be worked at a much higher speed than a coherer, Mr. Marconi said he was fortunate enough to succeed in constructing a magnetic detector of electric waves, based on a principle essentially different from that of the coherer and which he thinks leaves all coherers far behind in speed, facility of adjustment and efficiency when worked in tuned circuits. This detector, which has just been described in detail before the Royal Society, possesses a sensitiveness which surpasses that of the best coherer.

The magnetization and demagnetization of steel needles by the effect of electrical oscillations has long been known, and was noted especially by Prof. T. Henry, Aloria, Lord Rayleigh and others. Mr. E. Rutherford also has described a magnetic detector of electric waves, based on the partial demagnetization of a small core composed of fine steel needles previously magnetized to saturation. By means of a magnetometer, Mr. Rutherford succeeded, in 1895, in tracing the effects of his electrical radiator up to a distance of three-quarters of a mile across Cambridge.

But Mr. Rutherford's arrangement is not suitable for the reception of telegraphic messages, in consequence of the fact that a careful process of remagnetization, which requires some time to effect, is necessary in order to restore its sensitiveness after the receipt of each impulse. Mr. Rutherford's arrangement is also considerably less sensitive than a coherer.

The detector about to be described is based upon the decrease of magnetic hysterisis, which takes place in iron when under certain conditions it is exposed to the effects of high-frequency oscillations or Hertzian waves. On a core of thin iron or steel, but preferably hard-drawn iron, are wound one or two layers of thin insulated

copper wire. Over this winding, insulating material is placed, and over this again another longer winding of thin copper wire contained in a narrow bobbin. The ends of the winding nearest the iron core are connected, one to earth and the other to an elevated conductor, or they may be connected to the secondary of a suitable receiving transformer or intensifying coil, such as are employed for syntonic wireless telegraphy. The ends of the other winding are connected to the terminals of a telephone or other suitable receiving instrument. Near the ends of the core or in close proximity to it is placed a horse-shoe magnet, which by a clock-work arrangement is so moved or revolved as to cause a slow and constant change or successive reversals in the magnetization of the piece of iron. It has been noticed that if electrical oscillations of suitable period be sent from a transmitter, rapid changes are effected in the magnetization of the iron wires, and these changes necessarily cause induced currents in the windings, which in their turn reproduce on the telephone with great clearness and distinctness the telegraphic signals which may be sent from the transmitting station. Should the magnet be removed or its movement stopped the receiver ceases to be perceptibly affected by the electric waves even when these are generated at very short distances from the radiator.

It has been noticed that the signals audible in the telephone are weakest when the poles of the rotating magnet have just passed the core and are increasing their distance from it, whilst they are strongest when the magnet's poles are approaching the core.

Good results have also been obtained by keeping the magnet fixed and using an endless iron rope or core of thin wires revolving on pulleys (worked by clockwork), which cause the iron to travel through the copper wire windings, in proximity to preferably two horse-shoe magnets, with their poles close to the windings, care being taken that their poles of the same sign are adjacent.

This detector has been successfully employed for some time in the reception of wireless telegraphic messages between St. Catherine's Point, Isle of Wight, and the North Haven, Poole, over a distance of 30 miles; also between Poldhu, in Cornwall, and Poole, in Dorset, over a distance of 152 miles, of which 109 are over sea and 43 over high land.

It would, no doubt, be possible to obtain signals by causing the iron core to act directly on a telephone diaphragm, and in this case the secondary winding could be omitted.

This detector appears to be more sensitive and reliable than a coherer, nor does it require any of the adjustments or precautions which are necessary for the good working of the latter. It possesses a uniform and constant resistance, and as it will work with a much lower e. m. f., the secondaries of the tuning transformers can be made to possess much less inductance, their period of oscillation being regulated by a condenser in circuit with them, which condenser may be much larger (in consequence of the smaller inductance of the circuit) than those used for the same period of oscillation in a coherer circuit, with the result that the receiving circuits can be tuned much more accurately to a particular radiator of fairly persistent electric waves.

As a bell, a coherer in circuit with a relay working a bell can always be used, and if it is found possible to make the magnetic detector record on a registering instrument (as to the possibility of which the results of recent tests have left little doubt), it may be found possible to receive wireless telegraph messages at a speed of several hundred words a minute. At present, by means of this detector, it is possible to read about 30 words per minute. Mr. Marconi gave the following considerations as those which led him to the construction of the above-described detector:

It is a well know fact that after any change has taken place in the magnetic force, acting on a piece of iron, some time elapses before the corresponding change in the magnetic state of the iron is complete. If the applied magnetic force be caused to effect a cyclic variation, the corresponding induced magnetic variation in the iron will lag behind the changes in the applied force. To this tendency to lag behind Professor Ewing has given the name of magnetic hysteresis.

It has been shown also by Profs. Gerosa, Finzi and others that the effect of alternating-currents or high-frequency electrical oscillations acting upon iron is to reduce considerably the effects of magnetic hysterisis, causing the metal to respond readily to any influence which may tend to alter its magnetic condition.

The effect of electrical oscillations probably is to bring about a momentary release of the molecules of iron from the constraint in which they are ordinarily held, diminishing their retentiveness, and consequently decreasing the lag in the magnetic variation taking place in the iron. Mr. Marconi, therefore, anticipated that the group of electrical waves emitted by each spark of a Hertzian radiator would, if caused to act upon a piece of iron which is being subjected at the same time to a slowly varying magnetic force, produce sudden variations in its magnetic hysterisis, which would cause others of a sudden or jerky nature in its magnetic condition. In other words, the magnetization of the iron instead of slowly following the variations of the magnetic force applied gives a sort of jump each time it is affected by the electric waves emitted by each spark of the radiator.

These jerks in the magnetic condition of the iron, it was thought, would cause induced currents in a coil of wire, of strength sufficient to allow the signals transmitted to be detected intelligibly on a telephone, or, perhaps, even read on a mirror galvanometer. The results obtained go to confirm that this detector can be advantageously substituted for the coherer for the purpose of long-distance space telegraphy.

Mr. Marconi then proceeded to sketch the recent developments in the practical applications of his system, which have been exceedingly rapid. The Lloyds have adopted the system exclusively for use at their stations at home and abroad for a period of 14 years, and no less than 17 liners plying across the Atlantic carry permanent installations. In more than one case recorded in the daily papers, the system has been of service to vessels in distress, especially in the English Channel.

No less than 40 land stations (most of which are controlled by the Corporation of Lloyds) are being equipped with the system in Great Britain and Europe, and over 40 vessels in H. M. Navy carry installations. The adoption of the system in the Royal Navy has brought about a certain slight change of appearance in the rig of the ships. Some naval officers believe that this change improves the ships' appearance, others think the contrary.

The Italian Admiralty, after experimenting for some time with the self-decohering coherers referred to above, informed Mr. Marconi officially by a letter dated the 24th of May last, of its decision to equip their war vessels with the same apparatus as has been successfully employed on the transatlantic liners. On these liners, commercial use is made of the system for the convenience of passengers, and as an illustration of its commercial workableness, it was mentioned that lately the "Campania" and "Lucania," of the Cunard Line, have been collecting as much as $300 each trip in receipts derived from passengers' wireless messages.

Nearly two years ago the facility with which communication was possible over distances of nearly 200 miles, and the improvements in syntonic methods introduced, together with the ascertained fact of the non-interference of the curvature of the earth, led Mr. Marconi to decide to recommend the construction of a large power station in Cornwall, and another one at Cape Cod, Mass., U. S. A., in order to test whether by the employment of much greater power it might not be possible to transmit messages across the Atlantic, and establish a transoceanic commercial communication, which the monopoly of the Postmaster General will not apparently permit between two stations if both are situated in Great Britain.

An unfortunate accident to the masts at Cape Cod seemed likely to postpone the experiments for several months, when the conclusion was arrived at that whilst the necessary repairs there were being carried out, a purely temporary installation in Newfoundland should be used for the purpose of a transatlantic experiment, from which, at any rate, it might be judged how far the arrangements in Cornwall had been conducted on right lines. Before describing the results Mr. Marconi gave a brief description of the nature of the apparatus used at the transmitting and receiving stations.

The transmitter at Poldhu was similar in principle to the syntonic one above described, but the elevated conductor at the transmitting station was much larger, and the potential to which it was charged very much in excess, of any that had previously been employed, the amount of energy to be used in this transmitting station having been approximately determined prior to its erection.

The transmitting elevated conductor consisted of 50 almost vertical naked copper wires, suspended at the top by a horizontal wire stretched between two poles, each 48 meters high, and placed 60 meters apart. These wires were separated from each other by a space of about one meter at the top, and, after converging together, were all connected to the transmitting instruments at the bottom.

The potential to which these conductors were charged during transmission was sufficient to cause sparking between the top of the said wires and an earthed conductor across a space of 30 centimeters of air.

The general engineering arrangements of the electric power station, erected at Poldhu for the execution of these plans and for creating the electric waves of the desired frequency, were made by Dr. J. A. Fleming, F. R. S., who also devised many of the details of the appliances for producing and controlling the electric oscillations. These, together with devices introduced by Marconi, and his special system of syntonization of inductive circuits, have provided an electric wave generating plant more powerful than any hitherto constructed. Mr. R. N. Vyvyan and Mr. W. S. Entwistle have also greatly assisted in the experiments carried out with the very high-tension electrical apparatus employed.

The first experiments were carried out in Newfoundland last December, and every assistance and encouragement was given by the Newfoundland government. As it was impossible at that time of the year to set up a permanent installation with poles, the experiments were carried out with receivers joined to a vertical wire about 400 feet long, elevated by a kite. This gave a very great deal of trouble, as in consequence of the variations of the wind, constant variations in the electrical capacity of the wire were caused.

The assistants in Cornwall had received instructions to send a success of Ss, followed by a short message at a certain prearranged speed every ten minutes, alternating with five minutes' rest during certain hours every day.

Owing to the constant variations in the capacity of the aerial wire it was soon found out that an ordinary syntonic receiver was not suitable, although a number of doubtful signals were at one time recorded. Various microphonic self-restoring coherers placed in the secondary circuit of a transformer were therefore tried, the signals being read on a telephone. With several of these coherers, signals were distinctly and accurately received, and only at the prearranged times; in many cases a succession of Ss being heard distinctly, although, probably in consequence of the weakness of the signals and the unreliability of the detector, no actual message could be deciphered.

The coherers which gave the signals were: one containing loose carbon filings, another, designed by Marconi himself, containing a mixture of carbon dust and cobalt filings, and, thirdly, the "Italian Navy Coherer," containing a globule of mercury between two plugs.

For the good results obtained, Mr. Marconi expressed his indebtedness to two of his assistants, Mr. G. S. Kemp and Mr. P. W. Paget, who gave very efficient aid during the tests, which the extremely severe weather prevailing in December in Newfoundland made exceedingly difficult to carry out. The result of these tests was sufficient to convince him and his assistants that with permanent stations at both sides of the Atlantic, and by the employment of a little more power, messages could be sent across the ocean with the same facility as across much shorter distances.

The experiments could not be continued or extended in consequence of the action which the Cable Company, which claims all telegraphic rights in Newfoundland, saw fit to take at the time. Having received a most generous invitation from the Government of the Dominion of Canada to continue operations in the Dominion, it was thought undesirable to continue the experiments in Newfoundland, which would probably have resulted in litigation with the telegraph company.

The Canadian Government, on the initiative of Sir Wilfrid Laurier and Mr. Fielding, has shown itself most enterprising in the matter, and not only encouraged the erection of a large station in Nova Scotia, but actually granted a subsidy of £16,000 toward the erection of this transatlantic station, the object of which is to communicate with England from the coast of Nova Scotia. It is anticipated that the Canadian station will be ready for further tests very shortly. Another station for the same purpose is being erected on the United States coast.

Towards the end of February of this year, it was thought desirable to test how far the messages transmitted by the powerful station at Poldhu could be detected on board a ship. The ship selected was the "Philadelphia," of the American Line. The receiving aerial conductor was fixed to the mast, the top of which was about 60 meters above sea level. As the elevated conductor was fixed and not floating about with a kite, as in the case of the Newfoundland experiments, very good results were obtained on an ordinary syntonic receiver, similar to those above described, and the signals were all recorded on tape by the ordinary Morse recorder.

Readable messages on tape were received up to a distance of 1,551 miles from Cornwall, and indications were received as far as 2,099 miles. Most of the messages were received in the presence of the captain or the chief officer of the ship, who were good enough to sign the tapes. Some of the tapes were shown in a frame, and the audience was invited to examine them at the conclusion of the discourse.

It is curious to observe that signals could not be received at over 900 miles by any of the self-restoring coherers. The reason for this lies probably in the fact that the tuned receiver when connected to a fixed aerial is more efficient.

Another result of considerable scientific interest was, that at distances of over 700 miles the signals transmitted during the day failed entirely, while those sent at night remained quite strong up to 1,551 miles, and were even decipherable up to a distance of 2,099 miles. This result may be due to the diselectrification of the very highly charged transmitting elevated conductor, operated by the influence of daylight. Mr. Marconi added, however, that he does not think that the effect of daylight will be to confine the working of transatlantic wireless telegraphy to the hours of darkness, as sufficient sending energy can be used during day time at the transmitting station to make up for loss of range of the signals, and, therefore, this business of communicating across the Atlantic will not be one of those works of darkness, with which some people connected with cable companies would seem disposed to class it.

It is, however, probable that had this effect of light been known at the time of the Newfoundland experiments, and receiving had been tried at night time, the results would have been much better than those that were obtained.

Wireless Telegraphy, an Electrostatic Effect?

BY PROF. J. W. GORE.

DURING the summer of 1900 Prof. W. C. A. Hammel and the writer made some experiments relative to a system of signaling to and from moving trains, when the question arose, How far could a wire the length of a car be placed from a telegraphic circuit, one end being connected with a coherer, so that the inductive effect of the current might still be sufficient to effectively operate the coherer? We tried placing the wire at various angles with the telegraphic circuit and found that the coherer responded even when apparently at right angles to the circuit.

Although my interest was aroused as to the nature of this effect, various other interests prevented further experimenting until the past session, when I directed the attention of some of my laboratory students to the problem. Some of their results, which I have since verified, may be of sufficient interest to note in your columns.

With the battery and coherer used it was necessary to have some inductance in circuit, such as a telegraph sounder or a small induction coil. Due precaution was taken to be assured that the effects were not the result of other than the causes mentioned. The antenna was placed quite accurately at right angles to the circuit. The coherer was effectively operated upon, making and breaking the circuit when the bare end of antenna touched the circuit; when the end of antenna was near or some distance beyond the circuit; when the antenna was doubled around the circuit or doubled back on itself and the end connected with the coherer. The effect is greater when a helix, having a conductor for its axis, is connected to the antenna, either end, the middle or both ends of helix being connected to the antenna.

Very decided effects were obtained in each of the above cases when one end of an open circuit was connected to a terminal of the secondary coil. In but a few of the cases were earth connections necessary, though the effects were increased by earth connections.

The results obtained seem to be due to the same cause that operates the coherer when an insulated conductor, near the end of the antenna has its potential suddenly changed—namely, electrostatic induction.

It may be a hasty, though it seems a legitimate inference from the experiments, that long-distance wireless telegraphy is an electrostatic, rather than a Hertzian wave effect; at any rate, I have

thought for the past few months that this appears to be the more plausible explanation.

An oscillatory electrostatic stress between the conductor (earth) affected ether and the freer ether above the earth, would produce waves that would be propagated around the earth. The better the earth conductor, the greater the electrostatic effect; the smoother the surface of the earth the less the waves would be distorted and deflected. These are conditions which are found favorable for transmission of wireless telegraphic signals.

The New Generating Plants of the Niagara Falls Power Company—II.

BY H. W. BUCK.

EXCITER PLANT.

The exciter plant in the new power house will be quite different in arrangement from the old one. The installation will be made complete with the exciter switchboard in a compartment recessed into the rock at the bottom of the main wheel pit, as shown in Fig. 1. This portion will eliminate the long shaft necessary with exciters placed on the main dynamo floor and will simplify the operation of the plant. The equipment will consist of four 150-kw compound-wound vertical shaft, 220-volt exciters, each coupled to an independent turbine, placed directly underneath. The speed is 750 r. p. m., and each exciter turbine is controlled by a separate governor. The exciter plant wiring diagram is shown in Fig. 8. It will be seen that the power house lights and auxiliary motors will be operated from this plant. A panel is also provided for interconnection with the exciter plant in power house No. 1. The double set of bus-bars permits of the separation of exciting circuits and lights and motors. The exciter compartment will be directly connected by telephone with the main generator switchboard.

As in all plants, the most important element for successful operation is the layout of the switchboard apparatus. The switchboard

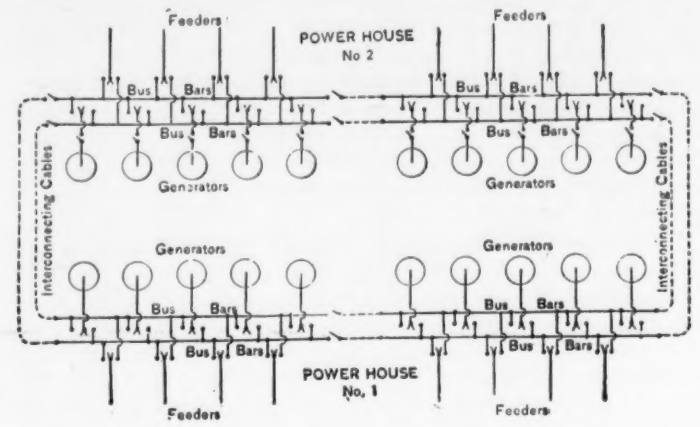
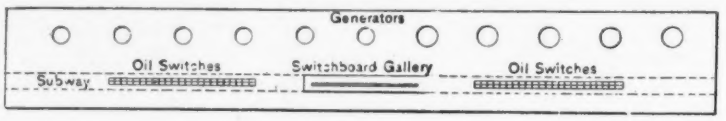
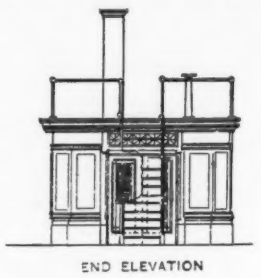


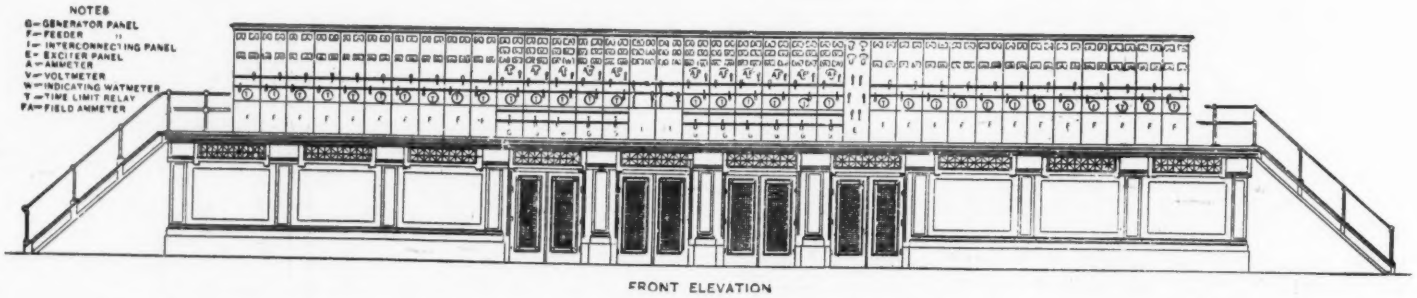
FIG. 6.—INTERCONNECTIONS BETWEEN AMERICAN POWER HOUSES.

shown in Fig. 7. All cables are led through the cable subway. They are heavily insulated with rubber, covered with a fireproof braid, and supported on brackets with porcelain clamp insulators.

The main switchboard consists of a gallery in the center of the building, having mounted on it 36 separate controlling panels: 11 generator, 22 feeder, 2 interconnecting and 1 exciter panel. The relative location of these panels can be seen in Fig. 5, together with their equipment. All the switching is done on these panels by means of relay switches placed in distinctive relation to one another, and in such a relation to imitation bus-bars placed throughout the face of the switchboard that the connections are clearly indicated, and no mistake in switching can easily be made. On the generator panels







FIGS. 4, 5 AND 5A.—FLOOR PLAN OF POWER HOUSE NO. 2 AND FRONT AND END ELEVATIONS OF MAIN SWITCHBOARD.

in power house No. 2 has been carefully considered, and is believed to be convenient and as simple as it can be made and still accomplish the desired results. There has been a tendency in the design of some of the recent large switchboards toward complexity and the installation of unessential appliances, which by their presence cause more trouble and confusion *per se* than they are intended to prevent. This has been avoided as far as possible in the design of this board.

Fig. 4 shows a plan of the power house floor and the relative positions of generators, switchboard gallery, oil switches and cable subway. Fig. 12 shows a section through the oil switches and cable subway, and indicates the location of the bus-bars placed in fireproof compartments. Fig. 5 shows a front elevation of the main switchboard gallery and controlling panels. The power house is divided in respect to switching into two parts, one of six generators and one of five. Each part has its own group of oil switches and its double set of bus-bars. Fig. 6 shows the relations between the two groups and also the interconnections with power house No. 1. All the switches in the new power house are the General Electric electrically-operated, oil-break type of the well-known design. This switch is are two selector relay switches and one generator relay switch; on the feeder panels are two relay selector switches, and on the interconnecting panels are relay interconnecting switches for making the various connections between the two groups in the new power house and between the two power houses. On the sub-bases of the generator panels are dummy exciter bus-bars, with relay double-throw generator field switches. All these relay switches operate electrically the real switches out on the power house floor, and have the exact relation to the dummy bus-bars which the real switches have to the real bus-bars, so that even a green man could hardly make a mistake in throwing a switch. Return indicators are placed adjacent to the relay switches so that the operator may tell at once whether the real switch has responded correctly to the movement of the relay.

There has been a considerable craze during the last few years for the operation of switchboard apparatus by bench-board control, but in designing the board for this plant, the bench-board system, although carefully considered, was rejected as inconvenient. In the bench-board system, the operator in switching must first go to the

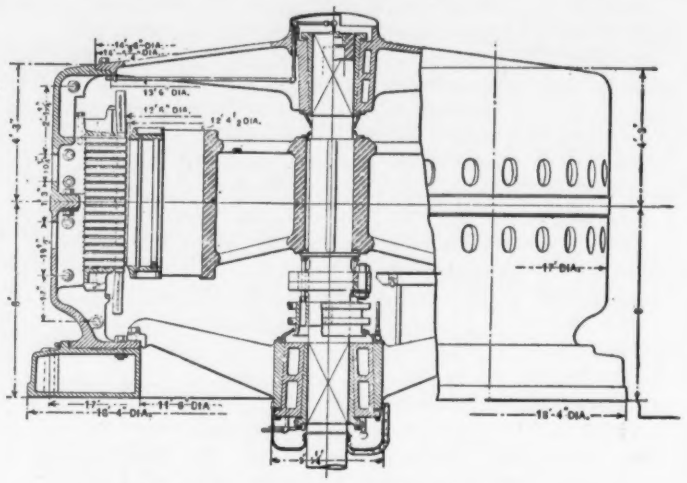


FIG. 9.—10,000-HP, 12,000-VOLT, THREE-PHASE GENERATOR, CANADIAN POWER HOUSE.

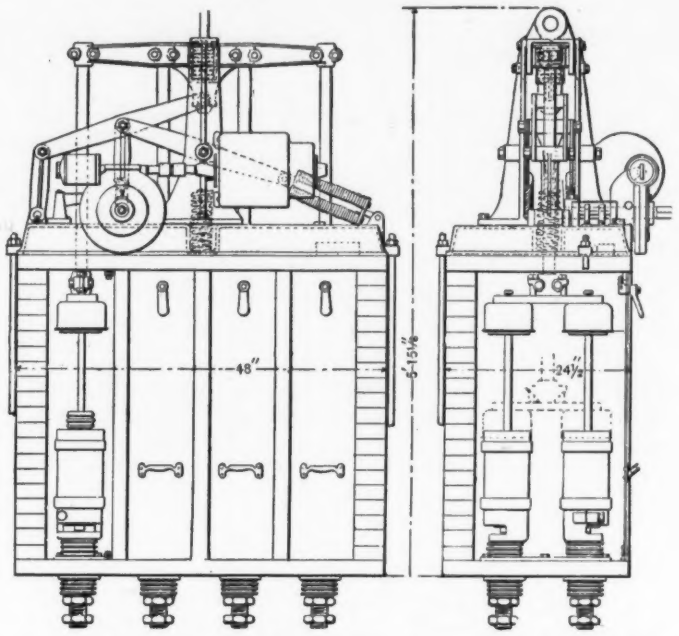


FIG. 7.—2,200-VOLT, TWO-PHASE ELECTRICALLY-OPERATED CIRCUIT BREAKER

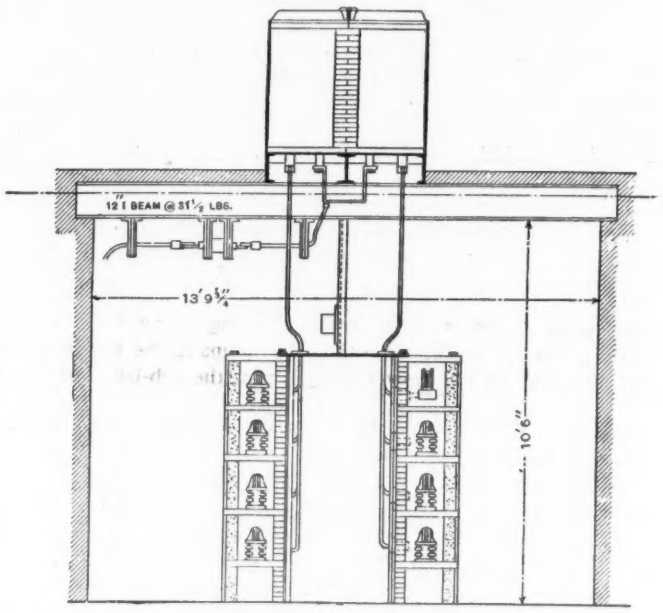


FIG. 10.—SECTION THROUGH CABLE SUBWAY UNDER OIL SWITCHES, SHOWING BUS-BARS, ETC.

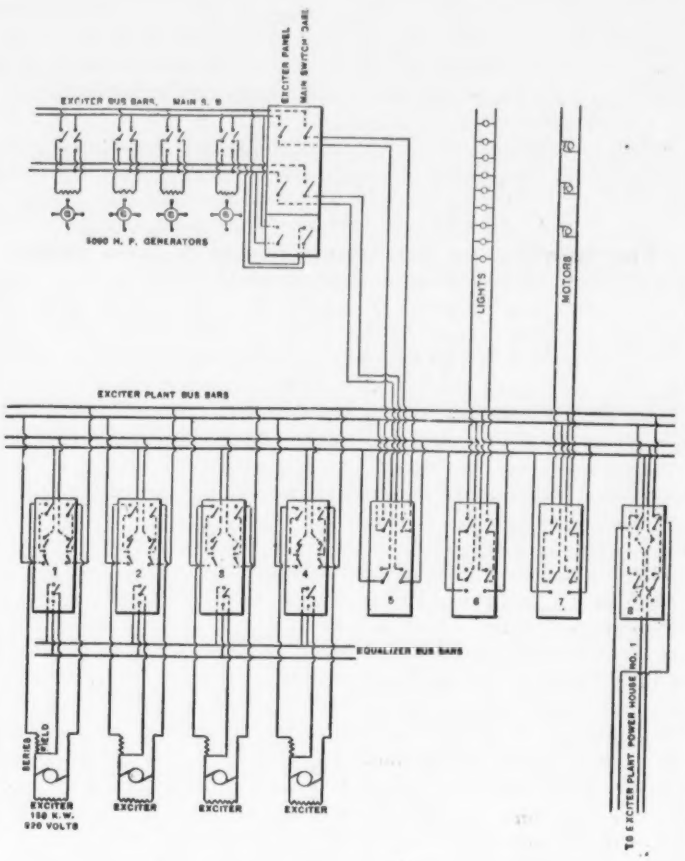


FIG. 8.—WIRING DIAGRAM OF EXCITER PLANT.

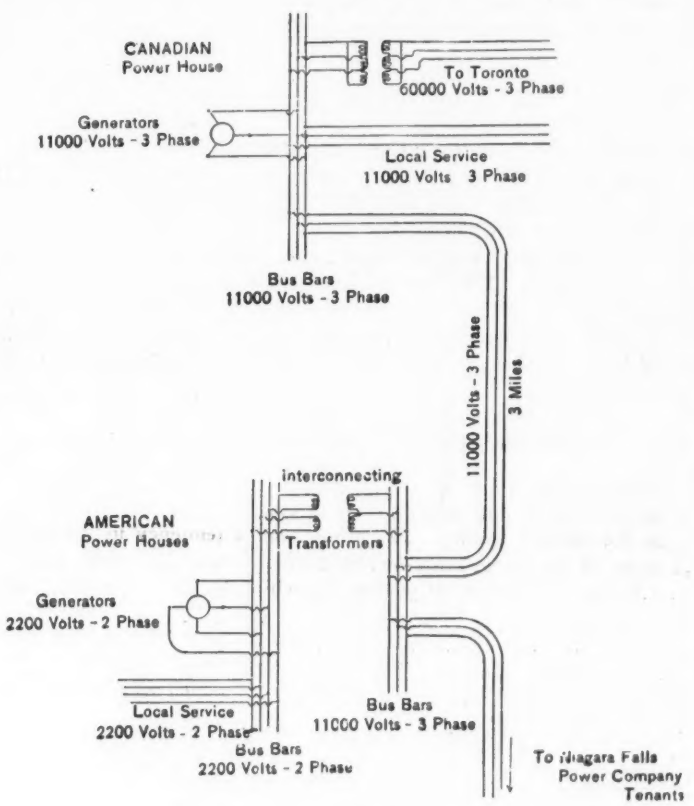


FIG. 11.—METHOD OF INTERCONNECTING AMERICAN AND CANADIAN POWER SYSTEMS.

NEW GENERATING PLANTS OF THE NIAGARA FALLS POWER COMPANY.

bench-board and pick out the relay switch in question, then taking his eye off the switch, he must pick out from a concentrated mass of instruments in front of him on entirely separate panels, the instruments involved in the movement which he is about to make. This is not altogether convenient, and there is always a chance of a mistake. It is believed that the advantages of this bench-board system are more imaginary than real.

In the switchboard installed in this plant, each panel is a complete unit, and comprises all the apparatus, both switches and instruments, which are necessary for any operation which may be made upon it. So that when the operator goes to a feeder or a generator panel he has before him, enclosed within the limits of the particular panel, all the apparatus with which he is concerned at the time. All synchronizing will be done by means of a Lincoln synchronizer placed upon a swivel on the top of the switchboard.

The generator field rheostats and field switches are located under the main switchboard gallery. All feeders are equipped with recording wattmeters installed in the basement of the new office building, through which the feeders pass at the end of the cable subway.

It is the intention to operate the 21 generators normally in four independent groups, but the interconnections are so arranged that they may all be operated in parallel if desired, or any one generator may be thrown on any group. These connections are shown in Fig. 10.

The feeder circuit breakers will be operated by time-limit relays, having an attachment devised by Mr. W. K. Gibboney, of the Power Company. A time-limit relay is a useful device for preventing a circuit breaker from opening unnecessarily at times of momentary overloads, but if a real short circuit occurs, it is objectionable. Experience has shown that on a system like that at Niagara, where there is a large amount of synchronous apparatus in operation, if a short circuit occurs it must be disconnected at once, or else the prolonged drop in voltage will cause all the synchronous apparatus to drop out of step; whereas, if the short circuit can be disconnected instantly, the inertia of the rotating parts of the synchronous apparatus will keep them in step for this short period. For this reason, the ordinary time limit relay is objectionable, since it causes a delay. The device referred to above consists of a dash pot attachment to the tripping plunger of the circuit breaker. This retards the movement of the plunger and consequently the opening of the breaker for ordinary temporary overloads, but if a real short circuit occurs the pull on the plunger is so strong that the dash pot has no effect and the circuit breaker opens instantly.

THE CANADIAN PLANT.

Anticipating still further increase in the use of Niagara power, the Niagara Falls Power Company has, through its allied company, the Canadian Niagara Power Company, started work on its plant on the Canadian side of the Falls. This plant will be located in the Victoria Park, about 1,500 feet above the Horse-Shoe Falls. Its hydraulic feature will be similar to the American plants, with its intake canal, wheel-pit and discharge tunnel leading to the foot of the Horse-Shoe Falls. This power development will be used for the transmission of power to Toronto and other Canadian cities within transmission distance, and for the distribution of power to factories located in Canada in the neighborhood of the power house. It will also be used for the supply of power to the American power system, with which it will be arranged to operate in parallel.

The essential difference embodied in this plant will be in the size of unit and in the electrical arrangements. The unit will be of 10,000-hp capacity (7,500 kw), and the generators will be wound for 12,000 volts, three-phase. The frequency will be retained at 25 cycles for the sake of uniformity with the American plants, so as to permit of parallel operation. In selecting this size of unit, the American and Canadian systems were regarded as one. Since this is likely to reach ultimately an output of several hundred thousand horsepower, a unit of 10,000 hp is not a large proportion of the whole, and is not too large an amount of power to concentrate in one machine from the standpoint of convenience.

The principal advantage in a unit of this size over the smaller one is in the reduction in cost of development per horse-power. This reduction in cost results from:

1. Lower cost of generator per horse-power.
2. Lower cost of turbines per horse-power.
3. A 10,000-hp unit occupies only slightly more space than one of 5,000-hp capacity, which results, for a given plant output, in great reduction in length of wheel-pit, power house and fore-bay, and a consequent reduction in construction.

This generator is shown in assembly in Fig. 9. It is of the internal revolving-field, vertical shaft type. Its revolving field ring is built up of punched laminations, bolted together with joints lapped. This method of construction gives a uniform and definite strength of ring and high magnetic permeability. On account of the high speed, 250 r. p. m., the generator is very small as compared with some of the large engine-driven units, its over-all diameter being only about 19 feet. The weight of the revolving part of the machine is 141,000 lbs., with a flywheel effect at 250 r. p. m. of 2,000,000,000.

The generators are wound directly for 12,000 volts three-phase, instead of 2,300 volts two-phase, as in the American plants. This high voltage was selected, not for long-distance transmission, but for economy in distribution to power users near the power house. In distributing large amounts of power underground from a 2,300-volt, two-phase plant, after a radius of about one mile is exceeded, it becomes cheaper to transform to 12,000 volts, three-phase and distribute at this voltage than to supply power directly at 2,300 volts. From this it becomes evident that great economy results from the direct generation of the higher voltage. For long-distance transmission, step-up transformers will be used to raise the voltage to 22,000, 40,000 or 60,000 volts.

Fig. 11 shows the method which will be adopted for operating in parallel the American and Canadian systems. The connection will be made by triple conductor cables carried across the upper arch bridge over the Niagara Gorge. The paralleling will be done through step-down Scott connected transformers, as shown.

The switchboard and auxiliaries have not yet been decided upon for this power house. It is not expected that it will be in operation for a year or eighteen months.

Pittsburg Meeting of the American Association for the Advancement of Science.

In many respects the Pittsburg meeting of the American Association for the Advancement of Science and Affiliated Societies, from June 27 to July 3, has been one of the most successful which the association has ever had.

While the attendance has not been very large, yet it has been composed of members of the active working class, many of them being Fellows. The registration has shown 435 members of the A. A. A. S. in attendance; in addition to this there were about 200 members of the affiliated societies, bringing the total attendance up to 635.

The geographical distribution of members in attendance is especially interesting, nearly every state in the union being represented by five or more members. It is exceedingly gratifying to note that the attendance of active working members from the south has been double that from the same region at any other meeting.

The papers which have been read before the association proper and in joint session with the more closely affiliated societies have been numerous and of a high order. About 360 papers were presented, which is a large increase over the number read the last meeting of the association. Of the numerous papers read, those presented by Sections B and D—Physics and Mechanical Science and Engineering, respectively—have been of an especially interesting nature.

A number of interesting papers relating to electrical subjects were read before the American Physical Society. Special mention might be made of two papers by L. A. Bauer, of the United States Coast and Geodetic Survey, entitled "Results of Recent Magnetic Investigations," illustrated by charts; and "Some Recent Interesting Magnetic Disturbances Registered at the Coast and Geodetic Survey Magnetic Observatories," illustrated by lantern slides; and another, "On the Action of a Condenser in an Induction Coil," by J. E. Ives, University of Cincinnati.

Mr. George A. Gibson, of the Westinghouse Electrical and Manufacturing Company, read a paper, entitled "The Electrical Industries of Pittsburg and their Economic Influence," in which he showed how greatly modern economic conditions had been influenced by electricity, and particularly through the means it affords for the cheap and efficient transmission and distribution of power. Mr. Gibson stated that the United States generates 69 per cent. of all the electrical energy used in the world, and 76 per cent. of that portion used in electric traction. It has 76½ per cent. of the electric railway mileage and 83½ per cent. of the electric cars.

A number of important measures concerning the future of the

association were considered, and amendments to the constitution of the A. A. A. S. were adopted, which will render the council more permanent in its membership, and undoubtedly more efficient in its work. The matter of giving publicity to the papers read was brought up at the general meeting and was acted upon favorably and unanimously. In the past, the press reports of the various papers read have been handled by the daily newspaper reporters, who invariably picked out what appeared to them to be humorous and eccentric utterances, which resulted in caricaturing rather than in treating seriously the papers and the authors. To prevent this in the future, each section and affiliated society will appoint a press secretary, who will make it his business to see that the proceedings are correctly and interestingly reported from day to day. About 60 new members were elected during the Pittsburg meeting, and 80 members were made Fellows.

A matter of interest to the electrical engineering profession is the election of Mr. George Westinghouse to an honorary Fellowship in the association. This honor was bestowed upon him in recognition of his inventive powers and executive abilities, which have aided so materially the great and substantial progress made in the field of applied science in the past decade, and for his encouragement to the men in his employ in the various Westinghouse industries to lend their talents to the advancement of pure science. This distinction is now shared with only one other living American, namely, Prof. Walcott Gibbs, of Yale University.

Socially, the Pittsburg meeting has been of an exceptional nature, all the educational, religious, business and social organizations in Pittsburg and Allegheny uniting in their efforts to make the meeting an unqualified success. Mrs. Wm. Thaw extended the courtesy of her beautiful home, "Lyndhurst," at Fifth Avenue and Beechwood Boulevard, on Wednesday afternoon. The Engineers' Society of Western Pennsylvania extended every courtesy to the visiting delegates, and the "Smoker" on the steamboat " Annie J. Roberts," on the Monongahela River, on Thursday night, will be long remembered by those that had the good fortune to be present.

Four extremely interesting public lectures were given to the citizens of Pittsburg by the association and affiliated societies, out of appreciation to the many courtesies and hospitalities extended during convention week. Dr. Leonard P. Kinnicutt, of Worcester, Mass., gave an illustrated lecture on the "Prevention of the Pollution of Streams by Modern Methods of Sewage Treatment." Dr. Chas. E. Bessey, of the University of Nebraska, interested his audience with an illustrated lecture, entitled "Evolution Among Microscopic Plants." Capt. Sibert, of the Local U. S. Engineers' Office, gave an illustrated lecture upon his experience in the Philippines in repairing damages to bridges and railroads which were inflicted by retreating insurgents. Robt. T. Hill, of the U. S. Geographical Society, gave a lecture to an audience that crowded the Carnegie Music Hall to the doors on his experience on the Island of Martinique during the recent volcanic eruptions.

President Ira Remsen, of the John Hopkins University, was elected president of the association, and will succeed President Asaph Hall at the next meeting, which will be held at Washington, D. C., from Dec. 28, 1902, to Jan. 3, 1903.

In the section of physics a large number of important papers were read and discussed. Prof. Carhart brought forward some experiments which point very strongly toward a new theory of electrical cells. J. S. Shearer has taken up the study of expansion coefficients between the temperature of melting ice and that of liquid air. This work was called for in order that chemical apparatus for low temperature work may be properly designed.

Prof. Moler, of Cornell, described a very interesting plant in which a potential of 12,000 volts is got by running 24 dynamos of 500 volts each in series.

W. Ambler and F. Allen, after a careful set of experiments in a liquid air machine, find that 116 grains of this substance can be made by 1 hp in one hour, and that only about 2 per cent. of all the energy expended is stored up in the liquid.

Nichols and Hull have revised their determination of the pressure exerted by light, and find that it varies only 4 per cent. from that decuced from theory.

Dr. F. Allen presented some results of important bearing upon the theory of how we see colors.

The section of mechanical engineering and science was favored with an unusually large number of papers, many of them of the highest practical and scientific value.

Prof. R. H. Thurston gave a resumé of "The Trend of Progress in Prime Movers." While immense progress has been made in the efficiency of heat engines very much remains to be done. Steam turbines have become recently very important. But, of course, the efficiency of the turbine and of the ordinary steam engine are tending to the same point.

Mr. Frank H. Cilley, one of the engineers in charge of the construction on the new East River Extension Bridge, gave some interesting examples, showing that ordinary methods of determining the stress upon certain forms of framed structures are at fault—sometimes seriously so—because changes of form due to the act of loading at different stages of the process are not sufficiently considered. In this line of thought Prof. Thomas Gray, of the Rose Polyetchnic Institute, discussed the "Ratio of the Transverse to the Longitudinal Elastic Strain Produced by Longitudinal Stress." In a following paper, Prof. Gray showed it probable that the effect of hardening upon steel is to diminish its rigidity rather than to increase it, as is the common supposition.

Prof. Mansfield Merriman showed that one additional line of hose of the same size from a hydrant reinforcing a stream already in action increases the nozzle efficiency by about 40 per cent., a third line by about 25 per cent., a fourth by about 10 per cent., while the increase from a fifth or sixth line or more is too small to be of value.

Prof. R. S. Woodward, of Columbia University, entertained the section by a discussion of some of the curious uncertainties still existing in the meaning of the language of engineers. He suggested what he considers necessary reforms in the technical language of engineers. His position, however, aroused a lively controversy, in which the well-known engineer, Mr. Wm. Kent, led the opposition to Dr. Woodward.

Prof. David P. Todd, of Amherst, gave the section some account of a planetary orrery mechanism for showing the motion of the heavenly bodies, now in process of construction at Amherst, and occupying a building of more than 60 feet diameter. He asked the section for some suggestions upon the mechanical arrangements of this very large piece of school apparatus. Prof. J. Burkitt Webb gave a description of an ingenious device, by which with a telephone the strain upon a rotating shaft could be ascertained with great accuracy, also another device for showing the power exerted by floating automobile objects, like self-propelling torpedoes.

Prof. Gray showed that for high pressures, ball bearings become unsuitable and must be replaced by other devices.

An interesting contribution was that of Prof. Calvin M. Woodward, dean of the mechanical department of Washington University, of St. Louis. He is prominent on the committees which are regulating the various competitions to take place at the Louisiana Fair. He published before the section for the first time the rules and regulations which are to govern the contests in air navigation. This paper is of very great interest in describing prizes and methods, and will appear in full in the public prints. With this paper was given the section an account of the excellent scientific investigation in the line of aerodynamics, now being carried on at the University of Georgetown by Professors H. Matullath and A. S. Zahnm.

Professor H. T. Eddy, of Minnesota University, presented a valuable contribution, in which he had worked out to larger degree than heretofore the close analogy between pump action upon water under various conditions, and the action of an alternating electric current. So close is this analogy that the mathematical formulas adapted to deal with problems of water flow are exactly fitted to analogous problems involving the distribution of electricity, with the one modification of a difference in the interpretation of the constants involved.

Prof. J. C. Nagle, of the Texas Technical School, contributed an article upon the "Effect of Weeds and Moss upon the Coefficients of Discharge in Small Irrigating Canals."

Prof. Albert Kingsley gave an interesting paper, fully illustrated by diagrams, showing in original ways how the "Compound Pendulam"can be considered by graphic methods.

Mr. M. M. Kann, of Pittsburg, talked of "Crushed Steel and Steel Emery, an Artificial Abrasive." This is a recently invented form of steel, whose manufacture has grown up in Pittsburg and founded a new industry. The various grades of the product of this new company have replaced sand in rock sawing, emery in steel sawing, diamonds in core drilling of rocks, emery and other substances for

beveling, shaping and polishing various refractory materials, like granite, steel and glass.

Prof. W. T. Magruder illustrated a newly devised and simple method of determining with very small error the coefficient of v in the equation pv^n. This is the equation of the curve connected with the indicator diagram, by which the efficiency of various kinds of engines is measured. The special point in Prof. Magruder's paper was the use of the planimeter in the calculation of the important factor n.

Of the 45 papers read, either actually or by title, before Section B, Physics, 17 related to electrical subjects. The following is a summary of their contents:

"Contributions to the Theory of Concentration Cells," by Prof. H. S. Carhart. The paper dealt first with concentration cells of the first class, in which two electrodes of one metal are immersed in a solution of a salt of the same metal, the density of the solution being different at the two electrodes. The Nernst theory requires that the direction of the e. m. f. within the cell be from the dilute to the concentrated solution. The author has discovered a cell in which the e. m. f. is directed the other way, viz., from the concentrated to the diulte solution. It consists of nickel electrodes immersed in solutions of nickel sulphate or nickel chloride.

The explanation given depends on the thermal e. m. fs. at the two electrodes. Curves were given, showing that these e. m. fs. increase with the density of the solution. In most concentration cells the thermal e. m. f. is from the metal to the solution; in nickel cells it is in the other direction. Hence the reverse direction of the e. m. f. of these cells. These new facts were applied to the explanation of the dependency of the e. m. f. of the Daniell cell on the density of the two solutions, and to the reversal of the temperature coefficient of the Daniell cell when the density of the zinc sulphate solution is only slightly over unity.

The paper next took up the other class of concentration cells, in which the two electrodes are amalgams of a metal of different densities, the two amalgams being immersed in a single solution of the same metal. In these the thermal e. m. fs. increase when the density of the amalgam *decreases*. The direction of the e. m. f. within the cell from the concentrated to the dilute amalgam is thus explained.

Further, since the thermal e. m. f. increases with the density of the solution, and decreases with the density of the amalgam, it should be possible to make a concentration cell with the denser amalgam in the denser solution, and the weaker amalgam in the weaker solution, so that the e. m. f. of the cell would be zero. This has been found to be true.

"On the Complex Product of Electromotive Force, Current and Other Vectors," by Prof. Henry T. Eddy, University of Minnesota, Minneapolis. The rules which govern multiplication and the other processes of ordinary algebra are those of mere number in its arithmetical sense. But algebra necessarily admits the use of complex numbers, to which arithmetical processes, such as multiplication, are perfectly applicable. Such complex numbers used as factors are not physical vectors, though they are frequently represented geometrically as quasi vectors.

When a physical vector, such as a force or a velocity, expressed in complex notation is multiplied by a mere numerical complex, the ordinary rules of algebra still hold. But when we multiply together two physical vectors expressed in complex form in order to obtain their product, the result has a physical significance which imposes laws of operation differing from those of ordinary algebra, and the factors are found to be non-commutative. The paper contains a detailed comparison of the nature of the two kinds of complex products, especially directed to the consideration of the product of pairs of alternating vectors of the same frequency to show that the double frequency of such products does not arise in any way from the non-commutative character of the multiplication, as has been sometimes assumed.

"A Set of Direct-Current Dynamos Arranged in Series for High-Tension Work," by Prof. G. S. Moler, Cornell University. To get a direct-current potential of 12,000 volts, 24 separately excited dynamos of 500 volts each are joined in series like battery cells. The full-load current is .22 ampere. The operation of this plant has proved very satisfactory.

"Rayleigh's Alternate-Current Phasemeter," by Prof. E. S. Johonnott, Rose Polytechnic Institute. This instrument consists of a soft-iron needle suspended between two parallel coils at an angle of 45 degrees to the common axis. A study was made of the iron losses in choking coils when the power factor was varied.

"A Radiometric Receiver for Electric Waves," by Prof. G. F. Hull, Dartmouth College. Two silvered strips of glass or mica, of the proper length for the waves used, are marked at their centers by a fine diamond scratch. They are mounted vertically in the focus of a parabolic mirror, with their centers opposite and near two small thin mica vanes which are at the ends of an arm of a torsion balance. The resonators and torsion balance are placed under a bell jar from which the air can be exhausted. The radimetric action due to the heating at the mica scratches or high resistances can be observed by a telescope and scale. The sensitiveness can be made greater than that of the Klemencic thermo-element, and the deflections are quantitative.

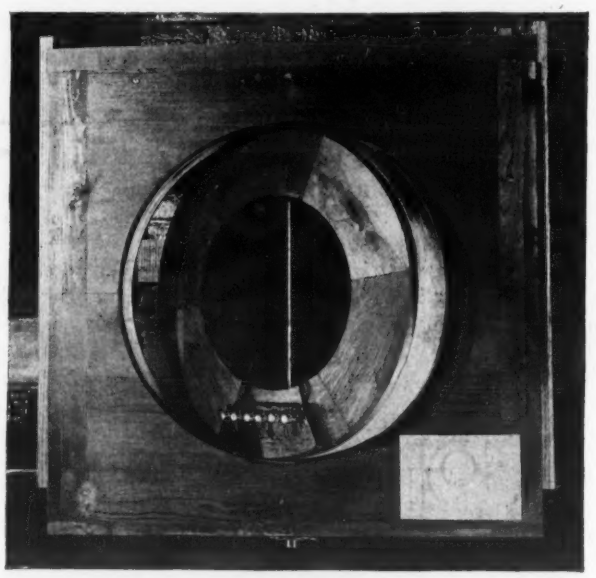
"Preliminary Note on the Effect of Percussion in Increasing Magnetic Intensity," by Prof. G. F. Stradling, University of Pennsylvania. Iron, steel and nickel are magnetized and then demagnetized by reversing the current. Percussion causes a development of poles in the same direction as before demagnetization. These increase in strength with tapping, and then grow weaker.

"The Electrical Conductivity of Saturated Powders," by Ernest Dorsey, Annapolis Junction, Md. The electrical conductivity of non-conducting powders saturated with electrolytic solutions is compared with the conductivity of the supernatant liquor. For coarse-grained powders the two are proportional, but when the powder is fine the conductivity of the saturated powder at first increases more rapidly than that of the supernatant liquor, with the result that for quite dilute solutions the conductivity of the saturated powder, as measured in a cubical cell, a pair of whose opposite sides served as electrodes, may even exceed that of a volume of the supernatant liquor equal to that of the solution in the powder as measured in the same cell.

"On the Conditions Controlling the Drop of Potential at the Electrodes in the Vacuum Tube Discharge," by Prof. C. A. Skinner, University of Nebraska. The drop of potential is explained by the presence of ions which strike the electrodes and rebound perhaps several times before they succeed in getting rid of their charges. Since the negative ions have greater freedom of motion than the positive ones, the accumulation of ions is different at the two ends of the tube, and consequently the fall of potential also differs.

"Some Observations Showing the Oscillatory Character of Lightning," by Prof. A. W. Smith, University of Mississippi. A drop of water falling during a lightning flash had several successive positions. A fence post photographed from a moving carriage gave six partially superimposed images. The period of oscillation was calculated to be from .02 to .03 second.

"A New Variable Ironless Induction Coil for Large Currents," by Prof. F. C. Caldwell, University of Ohio. This coil is interesting be-



INDUCTION COIL FOR LARGE CURRENTS.

cause of its large size. It is made up of two concentric coils, one swinging within the other, and wound on spools with spherical bottoms. The outer coil, which is removable, is mounted inside of a circular frame. In winding the outside coil, brass tubes were included

for the shaft of the inner coil to pass through, brushes carrying the current for the inner coil. Its resistance is 1.4 ohms, and its impedance, with 60-period current about 40 ohms. It is wound with 10 layers of 20 turns No. 8 wire in the outside coil, and 9 layers of 20 turns in the inside layer, about 100 pounds of wire; the outside diameter of inside coil being 20 inches.

"A New Laboratory Switchboard Jack," by Prof. F. C. Caldwell, Ohio State University. A convenient jack and plug of neat appearance were described. The cost of the plug is about 10 cents, and of a complete terminal with two tubes, 26 cents. One hundred amperes flowing for 15 minutes produced a scarcely perceptible rise of temperature in jacks which had been used for several months.

"On the Effect of Electrolytic Condensers in Alternating-Current Circuits," by Profs. A. Trowbridge and E. R. Wolcott, University of Wisconsin. An oscillograph of the Duddell type was used to get current and e. m. f. curves simultaneously. A comparison of these showed that there is a true phase difference. A sine wave is not distorted. Two aluminium electrodes in a solution of $Al_2 K_2 So_4$ gave the best results. A set of experiments made with platinum electrodes in sulphuric acid solution lead to these conclusions:

1. The current through the electrolytic cell is not in step with the applied e. m. f.

2. The higher the applied e. m. f., the higher is the value of the capacity.

3. The greater the distance between the electrodes, the less is the capacity, but the capacity is not inversely as the distance.

4. The equivalent resistance of the cell increases when the distance between the plates is increased.

Resonance effects were obtained.

It seems incorrect to regard the electrolytic condenser as two condensers in series, each consisting of an electrode, gas layer and the liquid.

"Photographic Study of the Alternating Arc," by Prof. Geo. A. Hoadley, Swarthmore College. Photographs taken from a rotating mirror mounted with its axis parallel to the line of the two carbons show two luminous intervals each cycle. When one carbon is replaced by zinc there is but one luminous interval each cycle. In this case a direct-current ammeter indicates the passage of 10 or 12 amperes from the zinc to the carbon in the arc.

When a magnet is held near the arc, the photographs, taken now from a mirror with its axis at right angles to the line of carbons, show alternate displacements of the bright band to the right and to the left. If the lower carbon is double, one half the current can be made to go to one part and the remaining half to the other part, thus splitting the alternating current into two intermittent direct currents.

Experiments were made between ordinary carbon points. Between carbon and zinc points, showing that there is an illuminating arc only once per cycle, and that there is a direct current passing from the zinc to the carbon in the arc, that can be read by a direct-current ammeter. Between carbon points in a magnetic field, showing the alternating directions of the current. Between carbon points, the lower of which is double, showing that two direct-current ammeters placed in the two lower branches will show to direct currents if placed in opposite directions.

"The Nernst Lamp," by A. J. Wurts. The substance of this interesting address has already appeared in the technical journals.

"The Electrolytic Rectifier," by Prof. K. E. Guthe, Ph. D. The paper describes the method of investigation, and is illustrated by means of curves showing the relation between the current and the polarization or condensation voltage with different metals and salt solutions. The cause of the effect is located in the gas layer at the anode.

"Model for Showing the Superposition of Two Oppositely Moving Wave-trains," by Prof. W. S. Franklin. This model is designed for class-room demonstration, and it consists of a large number of horizontal bars. One set of ends of these bars rests upon a wave-template and the other set of ends rest upon another wave-template. These two templates move in opposite directions at the same velocity. The middle point of the horizontal bars communicate to a row of points or balls, the resultant motion of the two wave-trains.

"The Emission of a Righi Vibrator and the Measurements of the Length of Electric Waves by the Interferometer," by Prof. H. R. Willard and L. E. Woodman, Hanover, N. H. The paper deals with the radiation emitted with a Righi vibration, which are studied in the first instance by their resonance effects on a receiver, the length of which is varied. The curves bring out the existence of two upper partial vibrations or overtones; in some cases the third overtone also appears. The wave lengths were later measured by the interferometer method.

"Effect of Percussion in Increasing Magnetic Intensity, by George Flowers Stradling, Philadelphia, Pa. When a rod of iron, steel or nickel has been magnetized and then demagnetized by the passage of a current of proper strength through the coil in which the rod is placed, tapping the rod causes the appearance of poles having the same direction as those existing before demagnetization. These poles, as the tapping continues, grow in strength to a maximum, and then decrease. If the demagnetizing current more than overcomes the original magnetism and produces poles in the opposite direction, still the effect of tapping is to make them first approach to those originally existing and then recede. In this case there are three stages produced by percussion. 1. Lessening of pole strength to zero. 2. Growth of pole strength in the direction existing before demagnetization. 3. Decrease of the strength of these newly acquired poles. Whether percussion increases or decreases pole strength depends on the previous magnetic history of the body examined.

"Portable Photometer for Measuring Light Distribution," by Prof. Dayton C. Miller. The arrangement described is a special form of photometer which may be moved in any way, as about a pivot, for quickly measuring with moderate accuracy the relative intensity of light sent out in any direction from a source. A Lummer-Brodhun screen is used to compare the light from the source with that from a standard illumination, the latter being capable of measured regulation from zero intensity to the maximum required. The application of the photometer to the measurement of the distribution of light throughout a room, as by a window prism, is described.

"On the Accuracy of the Zero in a Dynamophone," by Prof. J. Burkitt Webb, Stevens Institute. The dynamophone is a new dynamometer, in which the energy transmitted per revolution is measured by the twist of the shaft transmitting it, said twist being measured while the shaft is in motion by an electrical method in which no contact is made with the shaft. It consists of two armatures or hooked wheels mounted on the shaft at a sufficient distance from each other, each wheel having a telephone magnet with its coil mounted in front of it in such a way that it can be revolved about the shaft. The distance of the telephone magnets from the armatures is also adjustable. These two telephones are connected in series with a receiving telephone, which, when the two telephones are properly adjusted to opposite phases and equal amplitudes, gives no sound, or indicates zero. When the shaft twists under the transmission of a moment the observing telephone must be revolved through the angle of twist to obtain the zero or opposition of phase. As in some cases the observing magnet can be revolved through a small angle without perceptibly altering the zero, it is advisable to discuss the accuracy of the same, regarded as a question of the interference of waves of the same period with slightly different overtones, and to use a method of observation which avoids the difficulty to a great extent.

The retiring address of Vice-President D. B. Brace, of Section "B," physics, was on "The Group-Velocity and the Wave-Velocity of Light." He traced the history of the measurement of the velocity of light from the time of Galileo to the present day, both physical and astronomical methods. The highest accuracy at present attained was one part in five thousand. He showed that no method heretofore used in the laboratory had given the absolute velocity of light. He pointed out further that from astronomical observations light of all colors travel with the same velocity. He showed further that the observations by the American observers were superior to those of foreign observers. He showed further the bearing of electro-dynamic experiments upon the velocity of light. He pointed out the difference between what is called the group-velocity and the wave-velocity, and illustrated it by a group of waves on water, showing that the individual waves move with a different velocity than the average mean of all of them. He pointed out the connection with that of the velocity of light, and showed that no method had yet given the true absolute velocity. He described some new methods for determining each of these velocities, and light moves with a velocity of 185,000 miles per second; these methods could detect that there was such a thing as the velocity

of light in a distance of less than one inch, thus illustrating the extreme refinement of modern methods in research.

In following issues abstracts or reprints will appear of other papers of general interest read before the Association.

Telephone Work in Artillery Practice.

To supplant the wig-wag flag signalling heretofore used for reporting the artillery target practice at State Camp, Peekskill, N. Y., the electricians from the 13th Regiment, heavy artillery, New York, constructed recently, in record-breaking time, a flying telephone line between the gun station and the targets, a distance of nearly three miles, in one hour and a half. The telephone service enabled the gunners to ascertain the exact distance from the target a shot would strike, and corrections in their aim was not only greatly facilitated, but the danger of any men straying near the target at

FIG. 1.—RUNNING OUT THE TELEPHONE LINE.

the time of shooting was eliminated, as timely warning over the telephone was received from the gun station.

Taking with them only their telephone instruments, the detail of six men constructed a reel on an army wagon, and, procuring four miles of wire from the State Camp storekeeper, started off up the mountain, and in the time noted had the line run, instruments connected and communication established.

Just before the wagon started, one end of the line was connected to a telephone located at the gun station, and a ground connection was made to a water tap nearby. Following the wagon, one of the detail made tests along the line, making his temporary ground connections by submerging four ordinary tin wahs basins in brooks and streams crossed by the line, the wash basins being connected together in series, and the wire continued from the basins to the instrument. The country being well supplied with mountain brooks, frequent tests were made possible. At each test the camp was communicated with, and the progress of the constructing party reported, at the same time directions were sent both ways.

The line was kept in service two days, and was taken up by the reel-wagon in a little over an hour. The last night of the 13th men's stay in camp was marked by their work on two impromptu

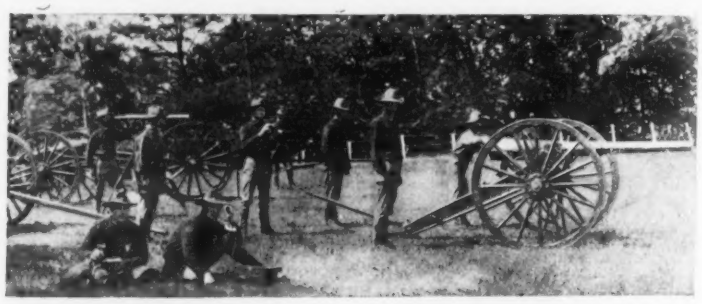


FIG. 2.—REPORTING ARTILLERY PRACTICE BY TELEPHONE.

submarine mines. Two beer kegs, with an ordinary 1-ampere fuse inserted in each, between two driven nails, and powder and wadding tamped in until the kegs were filled, completed the mines. From the nails in each keg, to which the fuse wire was attached, leads were brought to the outside for connection with an external circuit. The mines were removed to the landing at the State Camp, and, after the reels were placed in position on the landing, the first keg was rowed out in a skiff and submerged 200 yards off shore. As soon as the boat returned the mine was exploded by passing the electric lighting current, used at the camp, through the mine wires, burning out the 1-ampere fuse, thus igniting the powder. Larger fuses were inserted in the circuit at the dock end to protect the light wires in case of a short circuit through the water due to any possible poor insulation of the mine wires.

The second mine was laid with considerable difficulty. Darkness having set in, accompanied by a driving rain, the men in the boat were quite some time in placing the mine under an old wrecked schooner, some 400 yards off shore. Presently the boat got back to the landing, and the second mine was successfully exploded, in the same manner as the first. Both the telephone work and the laying of the mines were accomplished without a hitch, and the praise received by the men was well earned.

The electrical detachment of the regiment is a new departure, but a necessity, as the working of heavy artillery in coast defense is entirely dependent upon electrical communication. The method of operating the big coast defense guns being purely a mathematical proposition, and one in which more than one observation station is depended upon for the aiming and elevating of the guns, the introduction of electricity as a means of communication between stations has come to stay.

Electrolytic Treatment of Zinc Ores.—Bipolar Electrode.

BY CLINTON PAUL TOWNSEND.

In 1878 Cobley suggested the use of sulphur dioxide as a depolarizing agent in the electrolytic precipitation of copper with insoluble anodes. Copper sulphate solutions require for the separation of the metal a minimum e. m. f. of 1.24 volts, but by the use of this depolarizing gas to combine with the oxygen liberated at the anode, the theoretical minimum is reduced to .34 volt. This procedure has now been further studied by Constantin Jean Tossizza, of Paris, and found to give satisfactory results. In attempting, however, to apply the same method to the separation of zinc from its sulphate solutions, Tossizza finds that the high e. m. f. required becomes a disturbing factor, and that the sulphurous acid is itself electrolyzed with the known result (*Comptes Rendus* T. 85, page 225, Guerout) of anodic oxidation to sulphuric acid and cathode reduction to sulphuretted hydrogen or sulphur.

Tossizza now patents the following procedure for the separation of zinc—a two-part operation permitting the partial utilization of the depolarizing effect of the sulphur dioxid. Zinc is first deposited, using an anode of copper which dissolves to sulphate, the zinc separating in metallic form on the cathode; the resulting solution of copper sulphate is then electrolyzed with insoluble anodes depolarized by sulphur dioxide, the metal being deposited in the form of plates suitable for re-use as anodes in the electro-deposition of zinc.

The voltage theoretically required in the first stage of the process is 1.11, while that actually necessary at the very moderate current density used (40 amperes per square meter) is 1.5; and the copper is deposited in the second stage at a practicable minimum of .5 volt. Thus the total voltage required for the electro-deposition of the zinc is approximately two volts, as compared with the theoretical minimum with insoluble anodes of 2.35 (*Zeit. Phys. Chem.*, 1891, 8, page 299).

The principle of operation here offered is an interesting one, but in considering its commercial aspects it must be borne in mind that this somewhat small saving of energy is effected at the cost of a double manipulation, involving the electro-deposition of two distinct metals; and that the first operation, involving the separation of the sulphates of copper and zinc, can scarcely be carried out without a diaphragm.

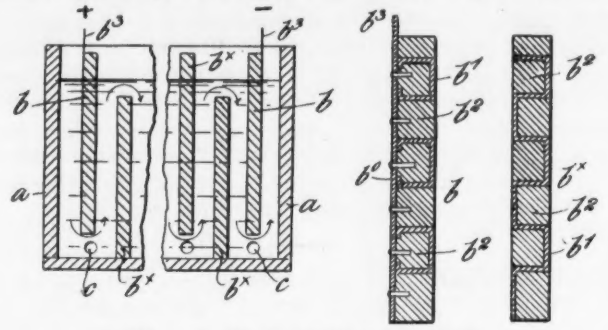
BIPOLAR ELECTRODE.

A form of bipolar electrode, constructed so far as its opposite active surfaces and intermediate conductive connections are concerned of platinum foil, and applicable to the electrolysis of sodium chlorid solutions and the production of hypochlorites, chlorates, etc., is shown in the accompanying figures, the device having been patented to August Alfred Vogelsang, of Dresden, Germany.

In Fig. 1 the slate tank *a* is shown as provided with a series of electrodes, *b*, arranged to divert the flowing electrolyte upward and downward between opposing surfaces. The terminal electrodes, *b*, are connected in the circuit b^3, the intermediate electrodes being unconnected, and hence functioning in the well-understood "bipolar" manner. A series of outlets, *c*, are provided for sludge. Fig. 2 shows one of the terminal electrodes consisting of bars of slate, b^2, sheathed by platinum foil b^1, the whole attached to a lead plate back-

ing, b^0, through which the electrical connection is made. The intermediate electrodes, b^x, shown in Fig. 3, take a similar form save for the omission of the backing plate. The platinum foil b^1, which constitutes the active electrode, is threaded back and forth between the slate bars, alternate surfaces being exposed upon opposite sides of the compound plate and connected therethrough by integral portions of the foil. As a modified construction, alternate bars may be entirely sheathed with the foil.

Kellner has heretofore described a somewhat similar construction wherein wires or plates of platinum were clamped between non-



FIGS. 1, 2 AND 3.—BIPOLAR ELECTRODE.

conducting bars, to form a bipolar electrode with integral connection between the faces. This was a device, however, for applying the "point" or "line" action, believed by Kellner to afford the best results in the electrolysis of brine, and the present construction may be regarded as an adaptation of the same to the use of conductive surfaces. The greatest economy of platinum is said to be obtained by such proportion of parts as will allow two amperes per square millimeter of section and 50 amperes per square decimeter of exposed surface. The foils used may be as thin as .01 inch or less.

New Telephone Patent.

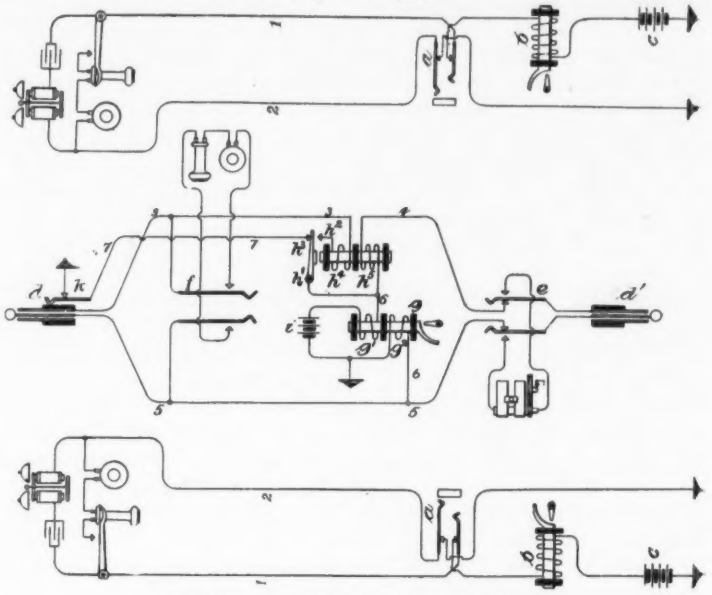
With telephone inventions the Patent Office seems to have struck a steady gait of one a week. The solitary telephone patent of the issue of July 1st is a re-issue to Mr. Charles E. Scribner, of Chicago, of a patent on a supervisory signal for telephone switchboards, originally issued December 5, 1899. Mr. Scribner in this invention employs a single supervisory signal for both lines, which acts when the called subscriber answers, and again when both subscribers hang up. The state of the art regarding supervisory signals is well summarized as follows:

It has been common in telephone switchboards of modern type to provide, in connection with united telephone lines, a source of current, a switch at each substation for controlling current in the line, and one or more supervisory signals associated with both or with each of the lines and responsive to such currents. In following some modes of supervising, a single supervisory signal has been provided in a bridge of the plug-circuit or link connector uniting the lines. This plan has been unsatisfactory in that it imparted to the operator no information as to the response of the called party. In other switchboards a supervisory signal has been provided in connection with each line, each signal responding only to current in its own line; but this plan is inefficient in that it requires the operator to observe two signals in order to ascertain the call for disconnection, and that it permits either of the two signals to be displayed at intervals during the connection, when its indication is of no assistance to the operator and serves merely to distract her attention.

The present invention applies to signalling systems of this general type, and aims to permit the display of a supervisory signal associated with the called line until the called party responds and thereafter to again permit its display only to indicate a call for disconnection in accordance with the replacement of both telephones on their switches at the substations. To this end it consists, in the combination with united lines or with link conductors for temporarily uniting lines, of a supervisory signal designed to come into a bridge of the line, together with a source of current, an electromagnet having a winding in each line, and switch-contacts controlled by the magnet adapted to connect the supervisory signal with the line of the called party when inert, and to connect it with both lines when excited, whereby the supervisory signal indicates a current in the line of the called party when the telephone at the called station is removed from its switch for use, but thereafter is controlled by current in both lines, and serves to indicate only the cessation of current in both. When the plugs or link conductors are not in use the signal remains hidden.

Referring to the accompanying diagram, two lines and stations and a connecting-cord set of a common battery system are shown, the latter having the usual ringing-key, e, and listening-key, f; d is the answering plug, and d^1 the calling plug. The supervisory signal g is controlled by relay h, which has an armature lever, h^1, playing between two contact anvils, h^2 and h^3. This relay has two windings, h^4 and h^5. Winding h^4 is connected in conductor 3 leading from contact h^3 to the sleeve of plug d; winding h^5 is connected in conductor 4, leading from switch-lever h^1 to the sleeve of plug d^1. The tips of the plugs are joined by a continuous conductor, 5. Supervisory signal g has two windnigs included serially in conductor 6, which forms a bridge uniting conductors 4 and 5. Battery i is in the bridge 6, between the two windings of g, which are of high impedance so as not to shunt the telephonic currents.

The plug d operates a plug-seat switch, k, controlling the continuity of conductor 7, which connects contact h^3 with the battery i, the connection being shown to earth; this conductor serves when h^1 and h^3 and k are closed to establish a local circuit containing the battery i and one or both windings of the signal g. Normally, relay h is inert and plug d being in its seat the local circuit just referred to is complete; therefore g is excited, and the indicator, which is designed to appear when g is inert, is hidden. When plug d is raised to answer a call, opening k, the local circuit is broken and the indicator of g is displayed. When d^1 is connected



SCRIBNER SUPERVISORY SIGNAL SYSTEM.

with the line called for the circuit through g remains broken, being open at the telephone switch at the substation until the called subscriber takes the telephone off the hook. Then the circuit between line wires 1 and 2 is closed completing a circuit through g and h as follows: from battery i, conductor 6 and one winding of g, through conductor 4, including winding h^5, to line 2 and back by line 1 to i by conductors 5 and 6, including the other winding of g.

The signal thus becomes excited and the indicator is concealed, signifying that the called station has responded. Magnet h being energized attracts h^1 into contact with h^2, uniting 3 and 4 into a continuous conductor between the sleeves of the two plugs. Thereafter current flows from the bridge 6 to both lines and h will remain excited as long as either line is in use. The current traversing g is also rendered independent of the condition of either station alone, so that the signal will remain hidden as long as either telephone is off its switch. When the receivers at both stations are replaced on the switches, current through the windings of both g and h is interrupted, and the magnets of both become inert. The indicator of g is displayed, this second display serving as the disconnection signal. The replacement of plug d in its seat closes switch k and re-establishes the local circuit which effects the restoration of the signal to its normal position of concealment.

This invention avoids all confusion of signals and eliminates all indications on the part of the signals except those which are found in practice to be essential to the proper establishment and supervision of the connection.

CURRENT NEWS AND NOTES.

LAUNCHES FOR ADIRONDACKS.—It would appear that electric launches are in favor in the Adirondack region this year. Several have lately been ordered for use on the St. Regis Lakes.

A LARGE LONDON CONTRACT.—London cables state that the value of the contracts secured by the British Westinghouse Company for the Metropolitan District Railway power house, at Chelsea, is said to be $5,000,000.

PARIS TRACTION.—A report comes from Paris that Messrs. Elkins and Widener are "making great efforts" to buy the underground railways of Paris and consolidate them with the trolley systems; and that Mr. Maurice Utermyer is acting as their counsel. The sum of $100,000,000 is said to be necessary.

ANOTHER GERMAN CABLE.—A cable dispatch from Berlin, of June 30, says: At a meeting to-day of the stockholders of the German Atlantic Cable Company the proposition of the directors to issue bonds to the amount of 20,000,000 marks ($4,760,000), in order to lay a second cable between Germany and the United States, was accepted.

AMERICAN ELECTROCHEMICAL SOCIETY.—The following members were elected at the July meeting of the Board of Directors: Chas. P. Steinmetz, Schenectady, N. Y.; George M. Brill, Chicago, Ill.; Edward L. Anderson, St. Louis, Mo.; Loren Gleason Waite, New York; Arthur Clarke Melcher, Newton Centre, Mass.; David Pepper, Jr., Philadelphia, Pa.; Wm. F. Doerflinger, Niagara Falls, N. Y.; Chas. M. Thomas, Nutley, N. J.; Henry E. Grunet, Basel, Switzerland; Dr. G. G. Pond, State College, Pa.; Edgar F. Price, Niagara Falls, N. Y. The total membership of the society is now 365, and a large number of applications are on file to be considered at the August meeting.

SCIENCE ABSTRACTS.—The total number of periodicals being abstracted for *Science Abstracts* is at present about 150. The following journals have been added since the beginning of the year: *Journal of the Russian Physico Chemical Society* (Russian); *Proceedings of Academy of Sciences, Amsterdam* (Dutch); *Proceedings of Academy of Sciences, Stockholm* (Swedish); *Proceedings of Academy of Sciences, Christiana* (Norwegian); *Proceedings of Academy of Sciences, Copenhagen* (Danish); *Zeitschrift für Anorganischen Chemie;* Royal Society of Edinburgh *Transactions and Proceedings; British Optical Journal; Elettricista* (*Rome*); Iron and Steel Institute *Transactions;* American Society of Mechanical Enigneers *Transactions; Engineering and Mining Journal* (New York); *Power* (New York); *American Telephone Journal* (Chicago); *La France Automobile; Der Motorwagen; Automobile Review* (Chicago); *Archives of the Röntgen Ray;* Philosophical Society of Washington *Bulletin.*

CANADIAN NIAGARA POWER PLANTS.—The Ontario Power Company, which is constructing a plant at Niagara Falls, to be fed from the Welland River, has applied to the commissioners of the Queen Victoria Niagara Falls Park for the right to construct a second in-take, this one to be directed from the Niagara River. Part of the plan was to build a dam in the rapids, in the vicinity of Dufferin Islands, and, with the head gained there, convey the water by conduit to the power house down to the upper suspension bridge. A supplementary agreement prepared provides that the company shall pay a rental of $30,000 a year instead of $15,000, and a certain rate per electrical horse-power per annum by the following scale: From 20,000 to 30,000 hp, $1; from 30,000 to 40,000 hp, 75 cents; over 40,000 hp, 5 cents. This application has called forth opposition from the Canadian Niagara Power Company, which is also building a plant for which water from the Niagara River will be utilized. The attorney-general of the province of Ontario will hear the parties at an early date.

COMPOSITE ARC ELECTRODES.—A new type of composite arc electrode is the subject of a patent issued July 1 to C. R. Boehm, Charlottenburg, Germany, which type is claimed to obviate the disadvantages incident heretofore to composite electrodes, such as unsteadiness of the arc, formation of slag and production of smoke and injurious vapors. Finely divided fluorides, such as fluorides of sodium, calcium and magnesium are intimately mixed. To one part of this mixture one part of pulverized carbon is added, and a paste formed by the addition of tar or other binding substance. In the case of cored carbons, the core is formed of a mixture of fluorides and carbon, to which is added a silicate. The magnesium fluoride is not reduced in the voltaic arc of the carbon, but is dissociated; the metallic magnesium thus produced being of an extraordinary reducing power, liberates the metals from their metallic salts so that the produced spectrum is a pure metal spectrum, whereas other arcs produced by metallic salts without the addition of magnesium fluoride show an impure spectrum of the salts or oxides employed, which are only partially reduced to metals. When the calcium fluoride is present, an intensely yellow light is produced, which, however, becomes of a flesh color when magnesium fluoride is present mixed with the other metallic salts in the proportion of equal or equivalent molecular weights.

THE TELEGRAPHS OF SALVADOR.—A recent report of the Director-General of the Department of Telegraph and Telephones of the Republic shows that there were 138 telegraph and 61 telephone offices in operation in Salvador in 1901, as compared with 117 telegraph and 49 telephone offices in 1900. The number of employes in 1901 in the two branches of the government service referred to was 433. The telegraph system of the country in 1901 consisted of 2,098 miles of telegraph lines, as compared with 2,029 miles in 1900. There were 1,032 miles of telephone lines in operation in 1901, as compared with 959 miles in 1900. The total length of the telegraph and telephone systems of the nation in 1901 aggregated 3,130 miles. In the 61 telephone offices in operation in 1901 there were 282 instruments employed in the government service, and 202 for private individuals. The number of official messages sent over the wires in 1901 amounted to 232,819, while the number of private telegrams rose to 397,310. The charges for transmitting these telegrams were $197,573.55. The receipts in 1901 for the forwarding of cablegrams over the government wires were $66,797.28, of which amount the cable company received $62,782.04, leaving $4,015.24 as the part corresponding to the government for this service. The total receipts in 1901 from telegraphs and telephones aggregated $344,406.74. The expenses of operation for the year, in both departments, were $325,444.99, which amount deducted from the gross receipts leaves a net profit to the government during the period referred to of $18,961.75.

LETTER TO THE EDITORS.

The Thunder Storm.

To the Editors of Electrical World and Engineer:

Sirs.—As thunder storms seem lately to have attracted particular attention, I may, perhaps, be allowed to give briefly my observation and views on the subject.

Thunder storms occur generally in this section of the United States in the summer, and more especially in the spring; they rarely occur in winter. The storms are generally absent when the wind is from between the north and south in the Eastern states. When they make their appearance from between the south and west, they are generally of a long duration, and frequently every cloud, no difference how small, is a thunder cloud. When they come from the west they are generally the evening storm, frequently accompanied by only one or two clouds, and are of short duration. When coming from the northwest they frequently, in early spring, are accompanied with hail; the lightning is of the most terrific character, but generally commences before or directly after the rain or hail begins to fall, and lasts but a short time after; and if no hail falls their duration is much shorter than the storm from the southwest, and something like in duration to those from the west.

When hail falls, the cloud as it approaches generally appears streaked with white, which may be caused by rain falling through a cold stratum of air and turning to hail. All thunder clouds appear to be in a rapid rotation of some kind. It has been stated that they rotate on horizontal axes, which judging from the appearance of the western and northwestern storms, would seem to be correct. It is

evident to my mind that heat, an initial charge, and a stratum of some kind are necessary for their production. The theory that they are immense condensing plates and nothing else, fails entirely to explain. Taking all things together, I would judge the thunder cloud to be an immense static or influence machine of fantastic shape in rotation, and the lightning is produced in somewhat the same manner as sparks from a static machine with Leyden jars attached.

Referring to the terrific storms of Mount Pelée, Prof. Hill says, that "following the salvos of detonation from the mountain, gigantic mushroom-shaped columns of smoke and cinders ascended into the clear starlit sky, and then spread in a vast black sheet to the south, directly over my head. Through this sheet, which extended ten miles from the crater, vivid and awful bolts flashed with alarming frequency. They followed distinct paths of ignition, but were different from ordinary lightning in that the bolts were horizontal and not perpendicular. This is indisputable evidence of the explosive oxidation of the gases after they left the crater."

Such a sheet would possibly have a vortex motion, and would be a different kind of static machine as to rotation from the ordinary thunder storm. There would be, as the mass passed through the crater of the volcano, a kind of hydroelectric machine, which would give a very great initial charge to the cloud in motion. I have read accounts of colored lights seen in the clouds above Mount Pelée; their varied colors could be explained as electric discharges passing through rarefied gases, producing Geissler effects.

BALTIMORE, MD. ALFRED G. DELL.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

DYNAMOS, MOTORS AND TRANSFORMERS.

Limits in the Construction of High and Slow-Speed Generators and Motors.—NIETHAMMER.—A paper, illustrated by diagrams, read before the Berlin Electrotechnical Society. The paper is extremely long, and deals with many details of construction, so that it is impossible to give a complete abstract. He first deals briefly with the efficiency. 0.95 to 0.97, not including friction of the bearings, are the higher limits, while on the other hand, even with small and low-speed motors the efficiency in general is not smaller than 0.7 or 0.8. Efficiencies of 20 or less per cent., as steam and gas engines have, occur in electric machines only in motors of less than 0.1 hp. The heating can easily be limited to a moderate degree in ventilated armatures, as long as the speed is high or medium, but not so easily in slow-speed machines. It is recommended to take as much care to obtain good ventilations in slow-speed dynamos as in those of high-speed; this leads to narrow machines of large diameter, and for direct current to a great number of poles. Properly distributed ventilation slots have a great influence. With inclosed machines the external box surface must be large enough to radiate all the heat at the gixen maximum temperature, and when used for continuous service, he recommends artificial cooling as in transformers; the water in mines is very suitable for that purpose. He shows that the rise of temperature of inclosed, and especially of artifically cooled machines, can be more easily predetermined than that of the open types. If ventilation and artificial cooling are provided for, which are not prohibitive concerning efficiency and price, especially for longer types, the heat does not represent a limit of the construction as long as sufficient space is available. This is not the case, however, with tramway and railway motors; he shows that for this purpose, as long as repeated starting is required, the three-phase motor is at a great disadvantage as compared with the direct-current motor. A very energetic artificial cooling would be necessary, which has not yet been tried in practice. This shows the justification of the many lines in America with 25-period, three-phase transmission synchronous converters and direct-current motors. "The American engineers have chosen this system after careful deliberation, and certainly not for the purpose of getting orders for more machines and apparatus, or because the three-phase appeared to involve difficulties. Besides, the General Electric Company (Schenectady) has perhaps worked more both practically and theoretically in three-phase lines than one thinks; even in Europe anyone may see a three-phase line installed by that General Electric Company, namely the line from Varese to Milan in Italy." For direct-current dynamos, one of the most important requirements is that there should be no sparking at the brushes; for this purpose it is necessary that the reactance voltage of the short-circuited coil is small; he discusses the influence of the type of winding, and gives the analytical method of calculating the reactance voltage. The limit of sparkless operation is determined by the centrifugal force of the armature and the solidity of the construction of commutator and brushes; for slow-speed machines there is no difficulty in avoiding sparks. He then discusses the limits of the voltage; for direct-current machines he gives it as 3,000 to 4,000 volts; for larger polyphase machines as 15,000; machines below 200-kw will scarcely be built for more than 5,000 volts. He then discusses the voltage regulation, and finally the limits in the mechanical construction of polyphase generators and motors. For three-phase railway motors, for which the airgap must be in general 1.5 to 3 times the value in stationary motors, difficulties occur concerning the power factor, especially in small types for tramways with low speed and a frequency of 50. The main-line motors have favorable values of speed and number of poles especially for frequencies between 15 and 30. The paper gives many numerical data concerning very high and very slow speed machines built by various firms. He concludes that all limitations in the construction of electric machines can be reduced to mechanical problems.—*Elek. Zeit.*, May 15; some corrections of misprints are given in *Elek. Zeit.*, June 5.

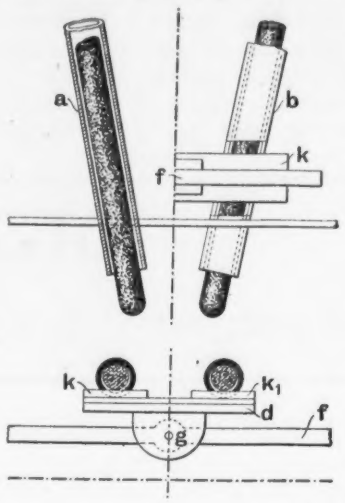
SCHIMPFF, KUEBLER.—Two communications in which the statements of Niethammer, concerning the prospect of three-phase traction, are criticised. Schimpff shows that the history of the development of electric traction in the United States has been such that there never was a real opportunity of deciding between direct-current and three-phase motors on the basis of their properties. The development of electric traction in the United States is, therefore, an argument against three-phase traction. Kuebler calls attention to Carus Wilson's comparison between direct-current traction on the South Side Elevated Railroad, in Chicago, with three-phase traction, which were rather in favor of the latter, as has been noticed before in the Digest.—*Elek. Zeit.*, June 5.

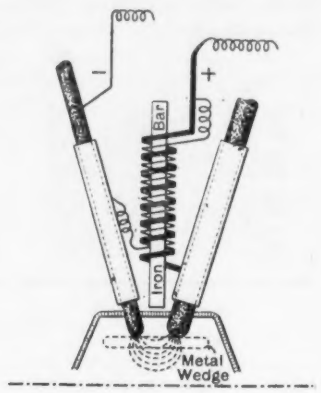
Induction Motors.—MEYER.—An article, illustrated by diagrams, in which he discusses the relative advantages of the squirrel-cage type and of the rheostatic motor. Eborall recently stated that squirrel-cage motors which have to start against load should not be used in sizes above 5 hp, and if not required to start against load, in sizes above 8 hp. The present author attacks this general statement, and claims that the service conditions alone decide which type should be chosen. The squirrel-cage type has the advantage of simplicity of construction and operation, adaptability to any number of poles, and thereby the possibility of using an efficient method of varying the speed by changing the number of poles in the stator only. It also has considerably better constants. The power factor is higher, since the self-induction of the end connections is greatly reduced, and since the passage of the currents in the rotor bars is more favorable; also the magnetizing current is generally less due to the lower densities in the rotor iron. The efficiency is better, since the copper is more efficiently used, as no dead copper in the shape of end connections is present, and since the wind resistance is smaller and all losses caused by brush friction and contact resistance are avoided. He gives some data of a 7.5-hp three-phase motor at 220 volts, which was first tested with a squirrel-cage rotor, and secondly with a wound rotor, slip-rings and outside resistance, using the same stator and the same bearings. The air gap was exactly the same in both cases. The core loss was 250 watts in both cases, the Joulean loss in the stator was 320 watts. Friction and windage loss was 125 watts for the squirrel-cage rotor, and 270 watts for the polar wound rotor. The Joulean loss in the rotor was 310 watts in the squirrel-cage rotor, and in the

polar-wound rotor 285 watts were found by test and 215 by calculation from the resistance of the windings, the difference being due to contact resistance. The efficiency at full load is 84.9 and 83.2 for the squirrel-cage rotor and the polar-wound rotor, respectively; the at half load, 84.1 and 80.6; the power factor is 89 and 88 at full load, and 77 and 75.6 at half load; the maximum output is 15.5 hp and 14 hp. The starting torque is 5.7 mkg. and 4.5 mkg. The starting current is 114 amperes and 26 amperes, the full-load current being 19.9 amperes; the rotor copper weighs 6 kg. From these figures he concludes that for motors which have to operate most of the time below their rated load, an appreciable annual saving in cost of current can be effected by choosing the squirrel-cage type. The only drawback is the large starting current, being in the above case 5.7 times its normal full load value, exerting at the same time a torque 1.46 times the full load running torque. It may be reduced successfully by using for starting a compensation, which acts as a transformer, reducing the potential at the terminals of the motors. By reducing the voltage to a certain fraction 1 to X, the current on the primary side and the starting torque are reduced to the fraction 1 to X square. A squirrel-cage type motor with a compensation may be obtained for approximately the same price as a rheostatic motor, including the resistance. In deciding whether a squirrel-cage motor can be used in a particular case, the size and quality of the generating plant and the character of the service are also to be considered. The generating plant should be large compared with the individual motors, at least from 10 to 12 times the kw-capacity which the largest motor has in horse-power. The larger this ratio, the less effect will be produced at starting. Further, the regulation of the generator should be good, say, between 5 and 7 per cent at full non-inductive load where a lighting load is to be supplied from the same bus-bars, and from 7 to 8 per cent. at full non-inductive load where power only is to be considered. In the first case, the lighting load itself will tend to improve the resulting power factor and thereby decrease the drop in volts produced at the moment of starting. In the second case, a drop in voltage, even of 15 to 20 per cent., should have no serious consequences, as all modern induction motors are designed with a liberal margin in over-load capacity, which will allow them to continue their operation even at such a reduced voltage. This refers, however, only to installations where motors have to start light or with a small load, say up to 30 per cent. of full load, and where compensators are used at starting. As to the character of the service, a good deal depends on whether the motor has to be started frequently or whether the process of starting occurs only once or twice in a day, or can be so arranged that the main station is notified beforehand. In such a case even "comparatively" large sizes of squirrel-cage motors can be successfully operated, particularly if the starting happens at periods where there is very little lighting to be done; for instance, a big motor driving a factory which has to be started early in the morning and perhaps at noon. On the other hand, he points to the advantage to be obtained from induction motors of the rheostatic type, if motors, which are large in comparison with the output of the generating plant, are required to start under full load and even overloads. For motors used for intermittent service, as in crane, hoist and elevator work, the maximum starting torque is mostly the deciding feature; since the working periods are mostly followed by periods of rest, such motors may be rated more liberally. For this kind of service he favors the slow-speed motor against the moderate speed motor.—Lond. *Elec.*, June 13.

LIGHTS AND LIGHTING.

Bremer Arc Lamp.—SAUBERMANN.—An illustrated paper read before the Vienna Electrical Society. The essential of Bremer's invention is the determination of the fact that, if the carbon electrode contains more than 20 to 25 per cent. of calcium, silicon or magnesium salts, a better utilization of the high temperature of the arc for the emission of light is obtained than has been possible hitherto in practice. The best result is with halogen combinations of metals of the berryllium group. According to Bremer, the increase of the proportion of the salt to 50 or 80 per cent. often occasions a still greater gain of light; the small strength of such composite carbons and their quick decomposition, even at moderately high temperatures, prevents their practical applications. As a matter of fact, in order to attain the necessary consistence and a certain rigidity, the electrodes containing 20 to 30 parts of calcium fluoride must be covered with a hard, glassy covering, formed by laying on a solution of a mixture of borax, silicic acid, soluble glass and similar substances. In addition, before the customary union by baking, the electrodes are provided with small quantities of boron, common salt, potash, tartar and various silicates, which, acting to a certain extent as fluxes, prevent the otherwise unavoidable scorifying of the carbon points. A particularly large arc is obtained, and this is a matter of considerable importance, as in the Bremer lamp the space between the electrodes is the chief source of light. The automatic method of pushing the carbons forward as they burn is indicated in Fig. 1.





FIGS. 1 AND 2.—BREMER ARC LAMP.

a and *b* are tubes which guide the carbons; they have a slit through which the clamping checks, *k* and *k'* press against the electrodes. *k* and *k'* are insulated from one another and fastened on the pressure plate *d*, in which two projecting metallic holders carry the arbor *g*. The latter is in direct connection with the electromagnetic regulating mechanism, and by means of it the keeper *f* acts on the plate. While the lamp is burning the keeper *f* exerts a suitable pressure upon the plate *d*, through the link *g*, this is conveyed equally to the two carbons. As the current through the arc decreases, a differential or shunt current passes through one magnet coil, the magnet draws the keeper back, the pressure on the two carbons is diminished equally, and they sink downwards. This decreases the resistance of the arc again, and the magnet comes out of action and allows the keeper to return to its former position, pressing the carbons against the sides of the tubes. Several Bremer lamps can be connected in series, and, as the two carbons are normally clamped fast and do not touch one another, the arc is struck as follows: When the current is switched on, part of it passes through the relay, and presses forward the keeper, allowing the carbons to slide down upon a metallic wedge which then supports them. The main current then finds a closed circuit through this wedge, and the shunt coils are no longer magnetized. Consequently, the carbons are once again clamped, and the metal wedge, which is fixed to a movable lever, drops back by its own weight. Now, the arc which is formed is subjected to the action of the series electromagnet, which drives it downward forcibly, and the action becomes greater as the arc approaches nearer to the magnet by the burning away of the carbons. The increased deflection increases the resistance of the arc, the magnet is exerted to a still greater extent, and acts upon the carbon feed as already described, the carbons falling by their own weight. In direct-current lamps only the positive carbon need be impregnated. Fig. 2 shows the arrangement of the differential winding, and is self-explanatory. He gives the results of some photometric measurements of Wedding, which have been noticed before in the Digest. The paper is also discussed in some editorial notes.—Lond. *Elec.*, June 20.

POWER.

Electrically-Driven Printing Machinery.—An illustrated description of a method of "parallel" driving, used by a British company, for large rotary web newspaper machines. The main motor is shunt-wound, and is geared to the machine driving shaft. An auxiliary motor, capable of giving a greater turning effort to the machine at slow speed than the large motor, drives the machine through worm gear and an electrically-operated claw clutch, the latter being so designed that it will come out of gear and stop the auxiliary motor as soon as the main motor overruns the auxiliary and drives the machine by itself. A very wide range of speed is obtained, and only about 10 per cent. of the full load power is required at the start. The main driving motor is of just sufficient size and power to drive

at full speed the printing machine to which it is geared, and this motor is never called upon to exert more than the full normal output, so that it works under the most economical conditions. The machine cannot be started from rest without using the auxiliary motor, though the power is always transmitted through the large motor shaft. The large motor is thus always in motion before it is called upon to exert any power.—Lond. *Elec. Rev.*, June 6.

Refuse Destruction.—Some notes on the combined refuse destruction and electric generating plant in use at Grays Thurrock, London. The electric station contains two steam sets of 100 kw each, a balancer booster and a storage battery. The boiler room contains two boilers for coal firing, which are used only when there is an insufficient supply of refuse to burn in the destructor. The destructor house contains two 2-grade Meldrum regenerative "simplex" destructors, working in conjunction with a boiler, and a regenerator for heating the air supplied to the furnaces. The normal burning capacity of each furnace is one ton per hour. The plant is in operation for only six or seven hours a day. The maximum load on the station is 80 kw, and this is easily maintained by the consumption of about 2 tons of refuse an hour. On an average 12 tons of refuse per day, corresponding to about six hours, are burned. The maximum output in kw-hours per ton averages about 35. Some figures are given of a 7-hour test, which is said to have made a record for London refuse destruction.—Lond. *Elec. Rev.*, June 6.

REFERENCES.

Electricity in Textile Mills.—OSBORNE.—An abstract of a paper read before the Dublin local section of the (Brit.) Inst. Elec. Eng., on lighting and driving textile mills by electricity. Concerning lighting, he discusses the advantages of the enclosed arc lamp over the open type. He then enumerates the well-known advantages of the use of electric power.—Lond. *Elec.*, June 6.

Electricity in Printing.—PERKINS.—An illustrated article of a general nature, on the modern use of electric power in printing plants. —*Sc. Am.*, June 14.

TRACTION.

Cardiff Tramways.—The first part of an illustrated description of the new British municipal tramway. The power house contains at present four 300-kw generators, which work as compound machines on tramway loads at 500 to 550 volts, and as shunt machines on lighting loads at 460 to 500 volts. There will also be installed two larger generators, each of 900 kw. An 80-kw motor-generator, working in conjunction with a battery, serves the following purposes. It receives current from the main tramway bus-bars at 500 volts, and gives out current at 100 to 140 volts for charging the battery or supplying the plant's lighting independently, which can also be supplied direct from the battery when the motor-generator is not work ing. It can also work in the reverse order and receive current direct from the battery at 100 volts, and give current at a pressure of 500 to 550 volts. The capacity of the battery is 2,100 or 1,620 ampere-hours when discharged in ten or four hours, respectively.—Lond. *Elec. Rev.*, June 6.

Electrolysis of Gas Mains.—SWINBURNE.—An abstract of a lecture before the Incorporated Gas Institute. He discusses the origin of the stray currents from the rails, and shows how they enter and leave the pipes with a resulting corrosion where they leave them. One of the chief safeguards is that the tramways must themselves be the chief sufferers by electrolysis, as they have not only their own rails to consider, but they also use lead-covered cables, which are very easily attacked, and destruction of these cables would be a very serious matter. The natural earth currents must have effects comparable with those of tramway leakage. Lead and iron service pipes in metallic contact with cast-iron mains are apt to be corroded without any extraneous currents. Time alone can show whether gas and water pipes will be seriously attacked when tramways are worked with the usual care.—Lond. *Elec.*, June 13.

Railway Shop.—An illustrated description of the electric power plant of the Fort Wayne, Ind., shops of the Penna. R. R. There are three 60-cycle, 220-volt, 100-kw three-phase generators, the currents being distributed by the four-wire system to induction motors, constant potential arc and incandescent lamps. Two 15-kw, 125-volt direct-current dynamos supply the exciting current, and also the current for charging storage batteries, and on some of the parlor cars for car lighting. The arrangement of the switchboard is described in detail. The car lighting department is experimenting with several systems of electric lighting of vestibuled trains.—*Elec. Rev.*, June 14.

REFERENCES.

Three-Phase Traction.—See the abstract of Niethammer's paper under dynamos.

Electrolysis of Underground Mains.—HUMISTON.—An illustrated paper read before the Western Gas Assn., in New Orleans, on electrolysis by tramway stray currents. He discusses briefly the various devices which have been suggested as remedies. He thinks the only absolute cure is a radical one: the entire insulation of both sides of the circuit from the ground; either by means of a double trolley system or some underground double contact device.—*Progr. Age*, June 16.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

French Central Station.—A long illustrated description of the new power house and network of the Est-Lumiere Co., of Paris. The central station, when completed, will have six units of 800 to 1,000 hp each, of which three have been installed. Each of the steam-driven dynamos is a 540-kw three-phase machine, with a power factor of 0.75; the frequency is 50, the number of poles 60; the magnet system serves as a flywheel. Direct current for excitation and for operating the pumps and for lighting the station is produced by 75-kw 125 volt direct-current dynamos coupled to three-phase motors. As a reserve of direct current, a storage battery of 400 amp-hours is used. The voltage of transmission is 5,000. Current is transmitted in three different directions by duplicate, underground, three-core cables to Ivry, Saint-Mande and Saint-Maur. In Ivry there had formerly been a three-wire 220-volt direct-current distribution; this is still used, the former generating station having been replaced by a substation in which 5,000-volt three-phase induction motors drive direct-current dynamos. In Saint-Maur there had been a 3,000-volt single-phase alternating-current supply, with 3,000 to 110-volt transformers, distributed over the network. This supply has been retained, and the old generating stations have been replaced by a substation in which three 100-kw transformers lower the voltage from 5,000 to 3,000. For the new districts no substations have been erected, but transformers are distributed over the districts, placed in overground boxes; the system of distribution is by 125-volt three-phase currents.—*L'Ind. Elec.*, May 10.

ELECTRO-PHYSICS AND MAGNETISM.

Mass and Charge of an Electron.—SEITZ.—An account of experiments in which he measured the ratio of the charge of an electron in absolute electromagnetic units to its apparent mass in grammes, by three different methods, these methods being that of Kaufmann and Simon, of finding the potential, Wien and Lenard's electrostatic deflection method, and Thomson's method of simultaneously determining the energy and the charge of the particles. In addition he determined the magetic deflection. Of all the methods investigated, that of Kaufman appeared to give the best and most consistent results. The magnetic deflection gave a value for the above ratio as 18,700,000, which agrees well with Simon's value, 18,650,000. (These are equal to 187,000,000 and 186,500,000 coulombs per gram; taking the effective mass of an electron as of the order, one gram divided by the twenty-seventh power of 10, the charge of one electron is 187 coulombs, divided by the twenty-first power of 10.) The bolometric method of determining energies is only suitable for high vacua and voltages of more than 8,500.—*Ann. d. Phys.*, No. 6; abstracted in Lond. *Elec.*, June 13; a correction of a figure in Lond. *Elec.*, June 20.

Conservation of Entropy.—ERSKINE.—An abstract of a (Brit.) Phys. Soc. paper. Heat energy may be expressed as the product of two factors—a quantity factor (entropy) and an intensity factor (temperature). The theory of the conservation of entropy holds in thermodynamics when dealing with reversible processes, and is analogous to the conservation of other quantity factors, such as momentum, moment of momentum and electric quantity. He shows the completeness of the analogies by considering Carnot cycles carried out on electrostatic and hydraulic engines. Wiedeburg has suggested to extend the doctrine of the conservation of entropy to irreversible processes by introducing a new quantity analogous to electric resistance. In the discussion which followed, Swinburne stated that the author had got hold of what was no doubt Clausius' original idea of entropy. The science of thermodynamics, as far as it deals with reversible processes, depends upon what the author calls conservation of entropy—but reversible processes do not exist in practice. The author's treatment is quite in accordance with orthodox thermodynamics.—Lond. *Elec.*, May 30.

Absorption of Radiation by Metals.—HAGEN AND RUBENS.—An account of experiments made in the German Reichsanstalt. They have begun a series of measurements of the absorptions shown by various metals with regard to ultra-violet, visible and infra-red rays, primarily with a view towards accumulating material for testing the electromagnetic theory of light. In this first set of observations they examined layers of platinum, gold and silver deposited on glass by various methods. The deposition of silver and its chemical and optical estimation enabled them to test whether sheets deposited chemically and by the disintegration of a cathode, had the same physical constitution. They found that they had, and that even transparent films of silver have the normal density. The curves of absorption given for the three metals extend over wave lengths 200 $\mu\mu$ to 1,400 $\mu\mu$. In the ultra-violet, silver shows a strong absorption band, and gold a less marked one in the blue. The curve for platinum is nearly straight, the absorption decreasing slowly towards the red. In the infra-red, silver shows the highest absorption, gold the next and platinum the least. This confirms Maxwell's postulate that for infinite wave lengths the absorptions are proportional to the conductivities, but the material is as yet too limited for general conclusions.—*Ann. d. Phys.*, No. 6; abstracted in Lond. *Elec.*, June 13.

Discharge Between Flames.—SEMENOV.—An account of an experimental investigation of discharges passing between a gas jet and a metallic point, or between two gas jets. With two Bunsen flames 10 cm high, and an induction coil, discharges may be obtained which show a characteristic behavior. The spark proceeds from the orifice of the jet connected with the positive pole, follows the dark external layer of the flame, then leaves it a little above the summit of the interior cone, and goes toward the negative flame. It does not reach the latter, however, but stops about 1 cm in front of it.—*Comptes Rendus*, May 26; abstracted in Lond. *Elec.*, June 13.

Inductive Circuit with Harmonically Varying Resistance.—MICUNO.—A brief mathematical article in which he deals with the case of an inductive circuit with a constant impressed e. m. f., while a part of the resistance of the circuit varies harmonically in magnitude. Such a circuit is realized by the insertion of a microphonic contact in an inductive circuit. The current is then oscillatory, but the current is almost indifferent to harmonic variation of the resistance, when the variation is small and the frequency is very great.—Lond. *Elec.*, May 30.

ELECTRO-CHEMISTRY AND BATTERIES.

Storage Battery Plate.—A description of a new storage battery plate devised by von Steckow, which is claimed to have a great superficial area with small transverse measurements. It consists of a frame, within which strips of lead wound in spiral form are fixed, one end of these strips being free in order to allow for contraction and expansion. The spirals, after fixing, are subjected to pressure in order to partially close the space between the spiral windings, and to bring their ends within the borders of the frame. A granular mass, which is afterwards dissolved out by water, may be utilized to advantage in this operation, in order to prevent the spaces between successive windings of the spiral from being entirely closed up. The electrode, after dissolving out this inert material in water, is ready for the electrolytic bath.—*Centralbl. f. Accum.*, June 1; Lond. *Elec.*, June 13.

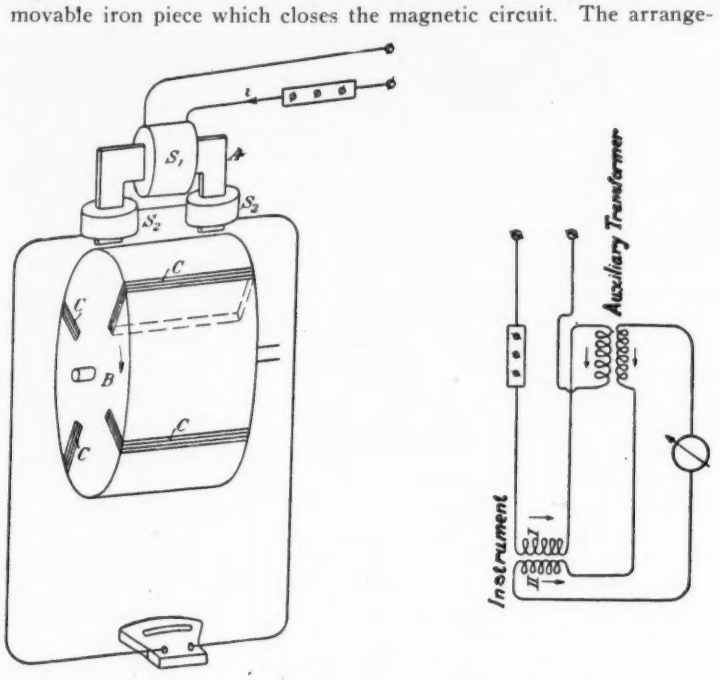
Electric Equipment of Carbide Works.—An illustrated description of the electric installation of the carbide plant at Flums, Switzerland. The hydraulic power station has a capacity of 2,400 hp, and is located 1.8 kilometers from the carbide plant. Three-phase currents are generated and transmitted at 5,000 volts. At the carbide works the voltage is reduced to 65, for use in the furnaces. There are 18 furnaces; they have the temperature of the electric arc, and the current is from 2,200 to 2,500 amperes, the numerous carbon electrodes being regulated by hand with chain gearing. To produce the carbides requires from 2½ to 3 hours, and the product remains another hour or hour and a half in the furnace for cooling after the current is shut off.—*West. Elec.*, June 14.

Edison Accumulator for Automobiles.—HIBBERT.—An article referring to recent newspaper reports. He cites two cases in which automobiles with lead cells ran distances of 95 and 100 miles, respectively, with one charge. "British manufacturers of electromobiles contemplate with confidence an early run of 150 miles on one charge of battery." "Still, all must hope that Mr. Edison will succeed. A serious competition with the lead storage cell will do it no harm. Unless the newcomer has such overwhelming advantage as to force lead right out of the field, it will quicken the mental energy, and, perhaps, increase the mental outlook of those responsible for the creditable performance of the present-day accumulator. But the general interest of electrical engineering will be served by producing definite and reliable data only."—Lond. *Elec. Rev.*, June 6.

Hydrogen-Chlorine Battery.—MUELLER.—An abstract of a paper giving an account of an experimental investigation of this gas battery. The electrolyte was hydrochloric acid, and the gases were continuously passed over the electrodes. When the acid solution was 1, 0.1, 0.01, 0.001 normal, the e. m. f. was 1.366, 1.485, 1.546, 1.587 volts. respectively. These values are not in agreement with those obtained theoretically under the simplest assumption concerning the dissociation of the acid. This is shown to be partly due to the hydrolysis of the chlorine which takes place, and which increases the concentration of the H and Cl ions. In 0.1 normal solution, the H or Cl concentration rises from 91 to 94.03 "millimols" (— thousandths of a gram molecule) per liter by this hydrolysis, in 0.001 normal solution from 0.98 to 30.48. With the aid of these concentration differences the calculated values of the e. m. f. agree better with the observed values, but the deviations remain greater than the experimental error.—Lond. *Elec. Eng.*, June 6.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Plotting Alternating-Current Curves.—GOLDSCHMIDT.—A description of an instrument for plotting alternating-current curves, which is based upon the following principle: If the field of a magnet, excited by alternating current, is traversed so rapidly by a coil that it completes the transit in a very small portion of the period of the alternating current, then the e. m. f. induced in the coil is proportional to the instantaneous value of the magnet field, and hence also to the instantaneous value of the magnetizing current. For the construction of the actual instrument he uses a slightly different arrangement. Both the primary magnetizing coil and the secondary coil in which an e. m. f. is induced are fixed, and both are brought together into an inductive relation for an instant by means of a movable iron piece which closes the magnetic circuit. The arrangement is shown in Fig. 1. Upon the horseshoe A of iron the primary coil S is wound, which is excited by the alternating current, and its arms bear two secondary coils, S_2, connected in series. The magnetic circuit is generally open, but at certain instants when the revolving copper drum B brings the iron plates, C, under the ends of the horseshoe, the magnetic circuit is momentarily closed. The drum is revolved synchronously, and the transformer can be moved into any desired position around the axis of the drum. The instantaneous value of the current at any desired phase is obtained by moving the transformer A to a corresponding position around the periphery of the drum. Placing both the primary and the secondary coils on the same iron has the disadvantage that the former induces some e. m. f. in the latter, even when the magnetic circuit is open; but this disturbing e. m. f. can readily be compensated by introducing an equal



FIGS. 1 AND 2.—PLOTTING ALTERNATING-CURRENT CURVES.

and opposite e. m. f. by means of an auxiliary transformer, as shown in Fig. 2.—*Elek. Zeit.*, June 5.

Temperature of the Arc.—FERY.—An account of some further experiments in radiation thermometry. He determined the temperature of the arc by a new method, using Wien's law, giving the radiation in terms of any chosen wave length instead of the total radiation, as in Stefan's law. Wien's formula is an exponential one of considerable complexity, but the author has compensated for this complexity by the following device. He reduces the standard radiation to equality with the radiation to be measured by interposing a very acute-angled prism of absorbing glass, and displacing it so as to interpose various thicknesses. It so happens that the absorption of the prism is also governed by an exponential formula of the Wien type, and the displacement is inversely proportional to the absolute temperature to be measured. The displacement actually found was 91 mm in red light and 49 mm in green light, giving 3,867 degrees for the temperature of the arc in the first case and 3,897 degrees in the second. This shows a considerable disagreement from the value obtained from Stefan's law, which was 3,490 degrees. He finds that this discrepancy is due to the fact that Stefan's law does not apply to this case, because carbon does not behave as an absolutely black body at the temperature of the arc.—*Comptes Rendus*, May 26; abstracted in Lond. *Elec.*, June 13.

High-Tension Testing Set.—AMBLER.—An illustrated description of a 12,000-volt direct-current testing set, installed in the dynamo laboratory of Sibley College. There are 27 machines in all, 24 of which are used to generate the high-pressure current, while the other three are used as exciters to separately excite the fields. The excitors are each of 0.25-hp capacity, designed to run at 1,900 r. p. m., and to deliver 1.05 amperes at 175 volts. The generators proper are each of approximately 1/6-hp capacity, designed for 2,500 r. p. m., with an output of 0.22 ampere at 500 volts. The machines are arranged in groups both mechanically and electrically. The circuit breaker in use is also described.—*Sibley Jour.*, June.

Large Static Machine.—BROOKS.—An illustrated article giving some notes on a large static machine for X-ray and general electro-therapeutic work. It comprises two distinct machines in one case: a Wimshurst-Holtz machine in the upper compartment and a Wimshurst in the lower. The lower machine is to supply an exciting charge to the upper or main machine whenever necessary, and also to supply static effects of low power for special treatment. The upper machine is said to have two noteworthy features, which are a double row of neutralizing pins to secure a more perfect discharge of the plate surfaces after passing the collecting combs, and the metallic connection between the inductor field plates on one side with the collecting combs; this latter connection is claimed to increase the reliability of the machine very much.—*Jour. of Elec.*, May.

TELEGRAPHY. TELEPHONY AND SIGNALS.

Telegraph Statistics.—ROSSI.—Some comparative tables concerning the telegraph service in several European cities. One table shows the average time occupied in each city by a message at the various stages of its transmission; the delay occurring in the transmitting office is always the largest; next comes the time required for transmission; the delay in the receiving station is smallest. A second table shows the average number of messages per day for different cities, the approximate number of staff and the average daily work of each member of the staff. The last figure is largest in Budapest and smallest in Bucharest; in Budapest the number of telegrams per employee per day averages 96.8, in Bucharest 33.3; in London and Paris the average number of telegrams daily are 475,000 and 120,000, respectively; the number of staff, 5,000 and 1,300, and the number of telegrams per employee per day, 95 and 92.3.—*Gionali dei Tel.* (Milan); Lond. *Elec. Rev.*, June 6.

REFERENCE.

General Energy Exchange.—An illustrated description of the new exchange of the Marion (Ind.) Telephone Company.—*Tel. Mag.*, May.

MISCELLANEOUS.

REFERENCES.

Patent Statistics.—WEBER.—A lecture held before the Berlin Elec. Soc'y, in which he gives a summary of statistical data on German patents in electrical engineering.—*Elek. Zeit.*, May 29.

Technical Drawings.—HEFNER-ALTENECK.—A paper read before the Berlin Elec. Soc'y, on uniform methods in technical drawings.—*Elek. Zeit.*, May 22.

New Book.

PRIMARY BATTERIES: Their Theory, Construction and Use. By W. R. Cooper. London: *The Electrician* Printing and Publishing Company. 324 pages, 131 illustrations. Price, 10.5 shillings.

The primary battery was the first type of an electric generator, and has been indispensable until the dynamo appeared. Even now it is of practical utility in certain cases. Besides, there is still a hope entertained by many that some day a new type of primary battery—a carbon cell—may be invented, which would overturn entirely the present conditions of generation of electric energy.

Mr. Cooper's book gives a very complete statement of the theory, construction and use of the primary battery in its present state, with some conservative discussions of what may be accomplished in future. The book has evidently been prepared with the greatest care, and the scattered literature of the subject has been well compiled. In the theoretical part, a considerable number of pages are devoted to a discussion of the modern theories of the ionic mechanism in a galvanic cell, based upon the views of the electrolytic dissociation theory. In the discussion of the construction and use of batteries, the author gives much that is not to be found elsewhere. He shows what the various kinds of batteries, such as Leclanche cells and dry cells, are capable of doing; he compares the capabilities of one type with another, and gives some interesting curves which he has obtained experimentally, enabling such comparisons to be made.

The book is divided into 12 chapters: Historical; the simple voltaic cell; non-chemical cells and thermopiles; testing cells; one-fluid cells; two-fluid cells; dry cells; standard cells; carbon-consuming cells, and the commercial generation of electrical energy. The chapter on standard cells is very good. In the last chapter the possibilities of a carbon cell are discussed, but the outlook is not very promising in the author's opinion.

Some small inaccuracies have been noticed by the reviewer. On page 298, in the discussion of the location of the oxidizing agent, in the case of a simple element of zinc, platinum and acid, the author says that it is "not essential that the zinc should be in contact with the acid"; this should rather have read that it is essential that the acid is in contact with the platinum, and Ostwald's very instructive experiment should be described. It is to be regretted that the author spells cathion with an h; although this is sometimes done, it is wrong, the correct spelling being *cathode* (from cata and hodos), and *cation* (from cata and ion, not hion). We also regret to note that the author has been chary in references and credit to the Continental workers, who established both the theory and the first forms of all the cells which have played any part in industry. On the other hand, undue prominence is given to the part played by the author's fellow-countrymen.

Directory of Electrical Societies, Etc.

AMERICAN ELECTOCHEMICAL SOCIETY. Next meeting, Niagara Falls, N. Y., Sept. 15, 16 and 17, 1902.

AMERICAN STREET RAILWAY ASSOCIATION. Next meeting, Detroit, Mich., Oct. 8, 9 and 10, 1902.

ASSOCIATION OF EDISON ILLUMINATING COMPANIES. Next meeting, September, 1902.

THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION. Annual meeting, Hotel Kaaterskill, Catskill Mountains, N. Y., Sept. 2, 3 and 4, 1902.

CANADIAN ELECTRICAL ASSOCIATION. Next meeting, Toronto, Ont., 1903.

ELECTRICAL CONTRACTOR'S ASSOCIATION OF NEW YORK. Semi-Annual meeting, Hotel Ten Eyck, Albany, N. Y., July 15, 1902.

INTERNATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS. Next meeting, Richmond, Va., Oct. 7, 8 and 9, 1902.

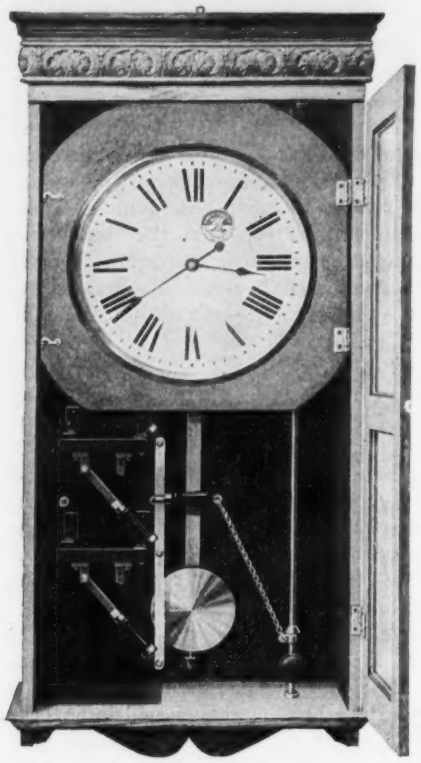
NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION. Annual meeting, Hotel Walton, Philadelphia, July 16, 1902.

NEW YORK STATE STREET RAILWAY ASSOCIATION. Next meeting, Caldwell, N. Y., Sept. 9 and 10, 1902.

OLD-TIME TELEGRAPHERS' ASSOCIATION AND UNITED STATES MILITARY TELEGRAPH CORPS. Next meeting, Salt Lake City, Utah, September, 1902.

Time Cut-Out Switch.

Many cheaply constructed time cut-outs for shutting off display lights in stores at a predetermined time have been put on the market in the past, but in the present cut-out or clock switch, which is manufactured by the Baird Manufacturing Company, of Chicago, no attempt has been made to lessen the cost at the expense of reliability and security from burnouts. The clock is a reliable Seth Thomas movement, and the power of the clock is not utilized in



TIME CUT-OUT SWITCH.

in falling, attains sufficient momentum to jerk the switch open with certainty. The switch, either double or triple pole, is of the plain jack-knife pattern. The switch, which is seen in the clock case below the movement in the accompanying engraving, it attached to the falling weight by a chain. When once the falling of the weights has pulled the switch blades from the jaws the switch will go full open by gravity. There can be no sticking at a partly open position, and consequently no destructive arcing. The switches themselves are substantial. It is endorsed by the National Board of Fire Underwriters. Although more expensive than if a cheap clock were used, the high-grade clock makes the device certain in action, and failures to turn off the lights where large circuits are to be handled might result in bills for current consumption that would soon make up the difference in cost between a good and poor clock. Furthermore, the clock switch is just as available as a public or private time-piece as any clock would be, and can be used for the double purpose of regulator and switch.

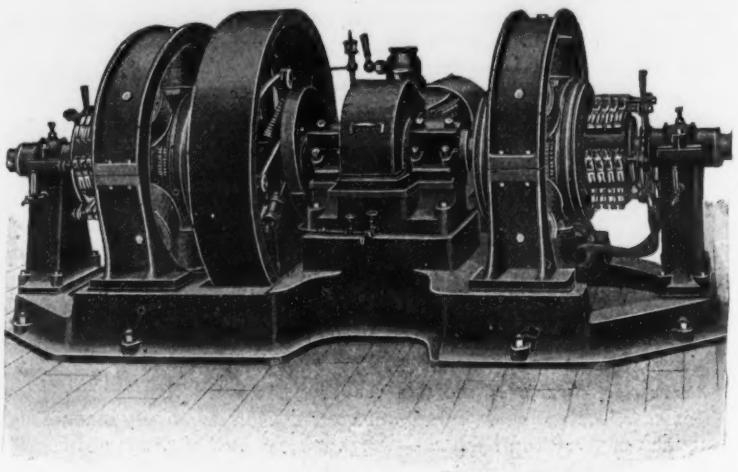
Double Generating Set.

In the accompanying engraving is shown a generating set, comprising a Buffalo forge horizontal center crank engine, and two direct-connected generators. The two generators and engine are bolted to the same cast-iron sub-base, the engine bed being near the center of the sub-base, and the field frames of the dynamos on either side. The two ends of the shaft are carried in out-board bearings, which are likewise secured to the sub-base. The main shaft carries the two armatures and the large governor wheel as well. The cylinders of this engine are provided with an efficient dead-air insulating space, and a polished sheet metal covering. The piston is made remarkably firm and light.

The crank shaft is a single forging of open-hearth steel, to which the counter-balancing discs are so fastened as to reduce the vibrating and shaking forces to a minimum. The connecting rod is of forged steel, and has a cross-head provided with a bronze box, which may be adjusted by means of a wedge and two screws. The crank end is of the locomotive strap type, with a wedge adjustment, and the boxes are lined with the babbitt metal.

The valve motion is obtained from an eccentric which is controlled by a shaft governor. This governor is especially adapted to the great regularity of speed required for electric lighting service. It is light and effective, and possesses two means of adjustment.

The lubrication has been most carefully considered. The crank disc and connecting rod are enclosed and run in oil, while the wrist pin bearing is provided with a cup which is supplied with oil from the same source. The out-board bearings are of the standard Buffalo adjustable type, ring-oiling and self-aligning. The entire



DOUBLE GENERATING SET.

oiling system of this engine is efficient and economical of lubricant. The engine is constructed by the Buffalo Forge Company, of Buffalo, N. Y.

Electric Hoists.

The hoist shown in the accompanying illustration is designed to transfer light work rapidly around ship yards, factories, etc., and when supplied with trolley carriage, geared hand cross-travel and bridge travel motor, to take the place of small traveling cranes. The manufacturers of this hoist, the Sprague Electric Company, claim for it many advantages over any other equipment heretofore put upon the market. It has a very high efficiency, and is much smaller and lighter than any other hoist of like capacity, and, provided it is not greatly overloaded, is almost indestructible.

All the different movements necessary for a traveling crane, namely, hoisting, lowering, cross-travel and bridge-travel, are controlled by a simple pulling of the chains and cords connected to the mechanism, and which can be operated by the ordinary workman to be found in the machine shop, factory or other place where the hoist may be used; no special crane operator or cage being necessary. This is a unique feature, to which special attention is called.

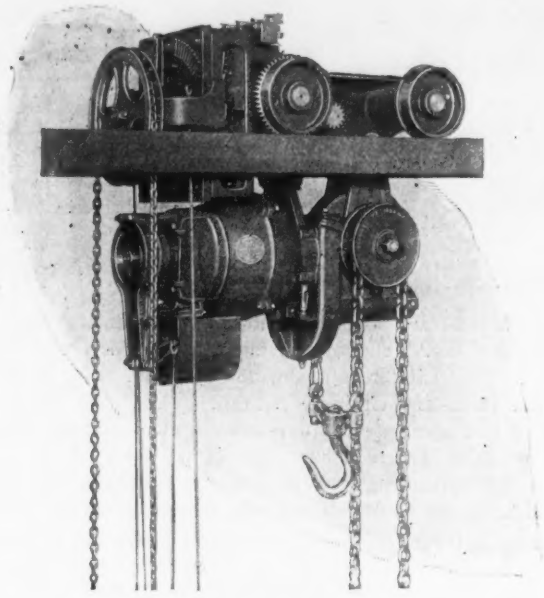
The apparatus consists of a chain and chain-wheel, connected by a hardened steel worm and bronze worm-wheel and steel spur gears to a standard Lundell enclosed round-type motor. The thrust of the worm is taken up by hardened steel rollers. The motor is provided with a rotary reversing switch, which works without the use of external resistance. All parts of this switch are made interchangeable.

The shaft of the hoisting motor is extended on the commutator end, and provided with a mechanical brake and brake-wheel. This brake is operated by a cam and spring, so arranged that when the starting and reversing switch is in the "off" position, the cam is disengaged, and the brake is set. In starting up the motor in either direction by pulling the cords attached to the switch-arm, the cam is thrown against the sides of the brake levers, and lifts the same off the wheel. This arrangement is much superior to a solenoid brake, and in actual practice it has been found that the work can be lifted from a state of rest and raised or lowered one-quarter of an inch or less.

The motor and hoisting mechanism can be hung from two hooks if only a hoisting and lowering motion is desired, or they can be attached to a trolley carriage arranged for cross-travel, either by pushing the load or by a geared hand-traverse motion. A bridge-travel is also provided, the controller for which is mounted on the end of the trolley carriage, as shown in cut. This controller is operated by cords, the handles of which are located near the work. The bridge-travel motor itself is mounted in some convenient position on the crane. The bridge-travel controller is reversible, and in practice it is possible to move the crane or hoist a distance back or forward not exceeding one-half inch.

As stated before, the motors furnished with this equipment are Lundell round-type motors, entirely enclosed, and the hoist can be operated out of doors if ordered of weather-proof construction. The resistance plates for the bridge-travel controller are glass grids, the resistance itself being entirely enclosed by the glass which is cast around the same. These grids have a very large overload capacity.

In designing this apparatus, the manufacturers have carefully kept in view the fact that it would be subjected to rough usage. All

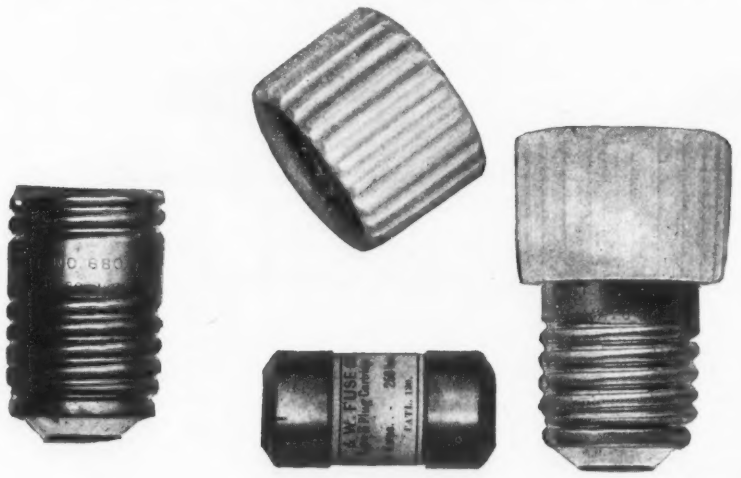


ELECTRIC HOIST.

parts are made of great solidity, and of the highest grade material, and all bearings have been made self-oiling, requiring but trifling attention at long intervals. The worm gear runs in oil and there is a slight oil gauge on the side of the gear case. The trolley carriage is provided with roller bearings, in order to decrease the effort necessary to operate the cross-travel. No resistance box is used for the hoist motor, and thus one source of annoyance and repairs is done away with entirely.

250-Volt Plug Fuse.

The D. & W. Fuse Company, Providence, R. I., has recently placed upon the market an improved form of 250-volt plug fuse, to fit the standard Edison cut-out. The illustrations show the plug assembled, and its several parts, consisting of the casing, porcelain cap and the small cartridge which contains the fuse proper. This company supplies cartridges which are interchangebale in capacities from 3 to



FUSE PLUG.

30 amperes. This little device was recently subjected to most severe trial, being directly short-circuited across a 250-volt circuit within 10 feet of the switchboard of a very large central station. The fuses repeatedly operated with freedom from flash, noise or discharge of any kind, and later were short-circuited directly across a 440-volt circuit under the same conditions, where they operated with like success, the only difference being that there was a slight noise at the instant of rupture of the fuse.

"Perfection" Rail Bond.

The Perfection Rail Bond Company, Monadnock Block, Chicago, is now placing on the market a type of rail bond, which embodies a number of new features. The underlying principle is that in order to make an efficient contact between a rail bond and rail,

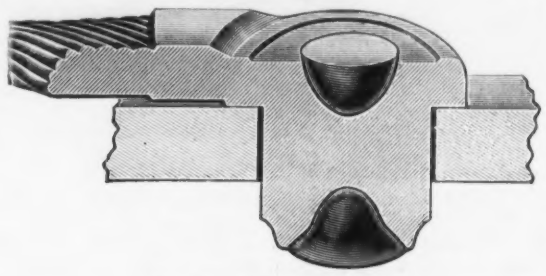


FIG. 1.—BOND IN PLACE.

the terminal must be expanded from its axis toward the surface, and that the pressure must be uniform radially. As will be seen from the illustrations, the "Perfection" bond consists of a plug terminal having cast in each end a semi-oval piece of hardened bronze. The inside bronze piece is slightly flanged so that when the two pieces are pressed home it will flange the bond plug against the rail. A hand compressor of convenient size is used to force the pieces into the bond plug and turn the flange. A movement of ¼ inch enlarges

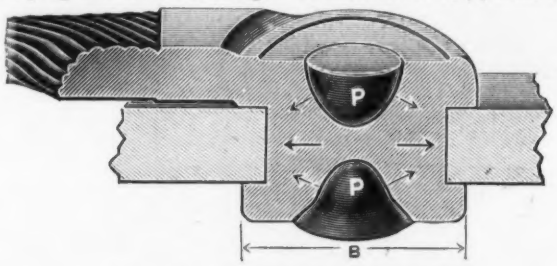


FIG. 2.—BOND AFTER COMPRESSION.

the bond terminal 3-16 inch, and form a rivet-head projecting ⅛ inch.

Fig. 1 shows a bond as entered, and Fig. 2 the same after the compressing operation. Fig. 3 shows a completed bond, which are made in any length from 4 inches up; the standard cross-sections for ⅞-inch terminals are from No. 2-0 to No. 4-0. Other styles than that shown have two cables either parallel, waved or bent to form short or long eyes. The copper cable is made integral with the terminals by a special process giving ample capacity for the current for which the bond is intended. The claims of superiority made for the "Perfection" bond are, that it insures the greatest possible pressure between rail and bond; best rivet head formed on the bond terminal; elimination of electrolytic action between the bond

FIG. 3.—COMPLETE BOND.

and its plugs; elimination of electrolytic action between the bond and the rail (no air space exists after the plugs are pressed home); ease of application; attainment of perfect contact, even if the hole is considerably larger than the bond terminal; limited pressure required in applying the bonds; the bond cannot be turned after being pressed in position; it cannot be driven out after being pressed in place; long life, due to great flexibility of the connecting cable, and freedom from crystallization.

An Improved Gravity Cell.

Mr. W. N. Gove, of Philadelphia, has recently been granted a patent for an improved gravity battery, the improvement consisting of an amalgamation of three different kinds of metal, which is substituted for the copper element. It is stated that one cell of this battery will do the work of two gravity cells in telegraph work. The new combination-metal, it is claimed, can be substituted for the copper element in other batteries.

Running Gear for Automobiles.

Running gear is now being specially produced for electric and gasoline automobiles, and a demand has grown up for large quantities of it. The Automobile and Cycle Parts Company, of Cleveland, Ohio, is manufacturing in its Smith stampings factory, at Milwaukee, gears for such work, which they call the Hercules, as here illustrated in Figs. 1, 2 and 3, showing the frame construction, a complete gear without motor or battery and a plan view with the motor in position.

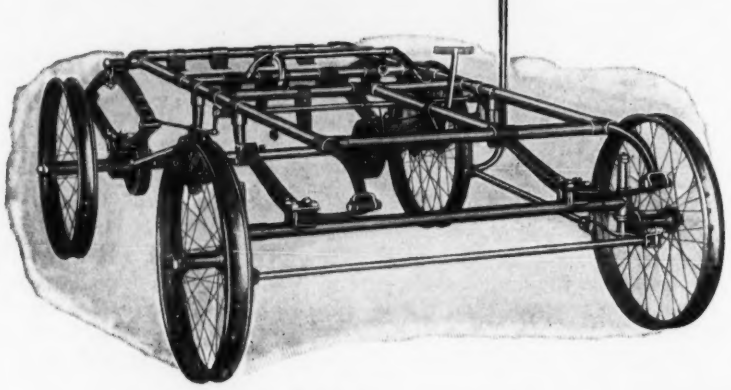


FIG. 2.—FRAME GEAR ASSEMBLED.

With regard to this apparatus, it may be noted that all tubing in the main frame is of high-grade steel, 1½ inches in diameter. The length of the frame from center of spring bolt to center of rear frame tube is 7 feet, and 8 feet from center of spring bolt to end of spring. The width of the frame is 32¼ inches, measured from center to center of side bars. This width will easily accommodate a 30-in. body, but by fitting close to the steering post a 36-in. body may be used. The side bars of the frame are of 10-gauge tubular stock, with reinforcing pieces extending in a forward direction for five feet. The construction of the motor carrier is such that if the motor should be violently swung in a lateral direction it would not be displaced. The frame is thoroughly braced to withstand any strains to which it may be subjected. The motor is permitted to swing by means of adjusting bolts which are fastened to two brackets attached to the cross bar of the frame.

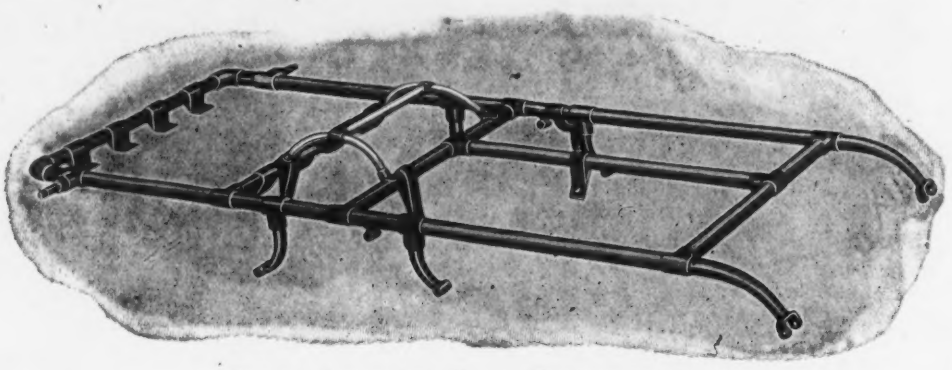


FIG. 1.—AUTOMOBILE FRAME CONSTRUCTION.

The battery board supporters, eight in number, are brazed to the frame. The rear struts are made of tubing. The front springs are of the three-leaf elliptical pattern. They are clipped to the axle. The rear springs are four-leaf elliptical pattern, bolted and clipped in place. The side bar tubes of the frame form the upper half of the front springs. When the main frame side tubes are connected with the front springs the tubing is tapered.

The steering lever is tubular, reinforced at its upper end to give strength where the knuckle is keyed on. The lower end of the lever is curved inwardly so as to form a crank. At the end of the curve a steel piece connects with a bronze knuckle joint, which actuates the connecting rod, and, through it, the steering spindle. The spindle is a one-piece forging.

The equalizing gear is composed of straight spur gears of bronze; the case being pressed out of one-eighth inch steel. The brakes are of the band-drum type. The front axle is tubular and reinforced throughout its length, and the rear axle is of solid steel 1½ inches in diameter.

The wheels are wire, with 30-in. x 3-in. tires, standard equipment. The bearings of the front wheels are fitted with ⅜-in. balls —12 in the outside bearing and 13 in the inside bearing. The track width is 4 feet 6 inches from center to center of wheels, which permits safe running in street railway tracks.

The wood wheels with which these gears may be equipped are made of A-grade stock. The spokes are set in a wood hub and staggered—a patent construction. The steel bushings are bored after they are inserted in the hubs. This insures true running wheels. The running gears are fitted with 1-inch pitch, ⅜-inch roller bearing chains, for which adjustment is effected by swinging the motor backward or forward.

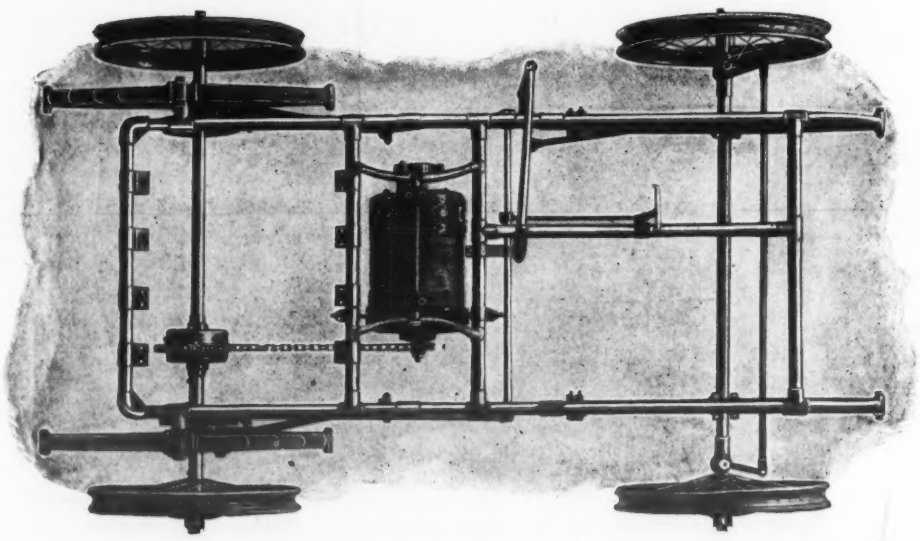


FIG. 3.—FRAME WITH MOTOR IN PLACE.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The large interest disbursements and other payments resulted in more or less disturbance of loans and in the calling of standing arrangements between institutions and stock market interests. The rate for call loans went as high as 7 per cent., while the bulk of business was from 4 to 6 per cent. Time money was not freely offered, the inquiry being also limited, the closing rates being 4¼ @ 4⅛ per cent. for 30 to 90 days and 4¾ @ 4¼ per cent. for four to six months. The stock market was strong, although activity was restricted by the two days' Stock Exchange holiday at the end of the week. Temporarily higher rates for money, caused by the large disbursements, had little effect upon the market. The favorable six months' statement of the United States Steel Corporation's earnings was well received, but pending the decision of the injunction suit the steel issues were quiet and firm. The traction group was neglected, although a good impression was produced by the fact that the Brooklyn Rapid Transit's earnings for May show a net increase. This stock closed at 67⅞, being a net gain of ¼ point, the number of shares sold being 9,980. Metropolitan Street Railway showed a little more firmness, closing at 149⅛, being a net gain of ¾ of a point. Trading in this stock was comparatively limited, the total number of shares sold being 2,610. General Electric showed some strength on limited trading, the highest figure reached being 310, closing at 308, a net gain of 3 points. The sales aggregated 1,000 shares. Westinghouse, common, lost 2 points net, closing at 208. Western Union closed at 87¾, being a net loss of 1½ points, the sales aggregating 10,200 shares. Other closing quotations at the end of the week were: American District Telegraph 38—a net gain of 1½ points; American Telephone and Telegraph 163—a net gain of ¼ point; American Telephone and Telegraph rights 15—a net gain of 1 point. In Boston American Telephone and Telegraph declined 13⅝ points during the week. Following are the closing quotations of July 8:

NEW YORK

	July 1.	July 8.		July 1.	July 8.
American Tel. & Cable..	—	—	Gen. Carriage (n. st'k)..	—	—
American Tel. & Tel....	163	—	Hudson River Tel.....	—	—
American Dist. Tel.....	38	—	Metropolitan St. Ry....	148⅜	147⅝
Brooklyn Rapid Transit.	67⅝	67½	N. E. Elec. Veh. Trns..	¾	—
Commercial Cable	—	—	N. Y. E. V. T. Co.....	12½	12
Electric Boat	28	30	N. Y. & N. J. Tel.....	—	—
Electric Boat pfd.....	40	50	Tel. & Tel. Co. of Am..	—	—
Electric Lead Reduc'n..	2¾	2¾	Western Union Tel.....	87	87¼
Electric Vehicle	6	6½	West. E. & M. Co.....	—	—
Electric Vehicle pfd.....	14	14	West. E. & M. C. pfd.	—	213
General Electric	—	—			

BOSTON

	July 1.	July 8.		July 1.	July 8.
Amer. Tel. & Tel. ex. rts.	163	166	Mexican Telephone	2¼	2¼
Cumberland Telephone..	—	—	New Eng. Tel. ex rts...	146	141
Edison Elec. Illum.....	280	—	Westinghouse Elec.	—	104
Western Telephone pfd.	—	103	Westinghouse Elec. pfd.	—	105
General Electric pfd....	—	308			

PHILADELPHIA

	July 1.	July 8.		July 1.	July 8.
American Railways.....	45¾	46	Phila. Traction	98¾	98½
Elec. Storage Battery...	90	—	Phil. Electric	—	5⅞
Elec. Storage Bat'y pfd.	90	90½	Pa. Elec. Vehicle.....	—	—
Elec. Co. of America....	5⅞	5⅞	Pa. Elec. Vehicle pfd...	—	—

CHICAGO

	July 1.	July 8.		July 1.	July 8.
Central Union Tel.....	—	—	National Carbon pfd...	97¾	102
Chicago Edison	—	179	Northwest Elev. com...	—	—
Chicago City Ry.....205		207¾	Union Traction	16⅞	14⅜
Chicago Teleph. Co.....	—	—	Union Traction pfd.....	—	51½
National Carbon	23	26			

ST. LAWRENCE POWER.—The St. Lawrence power plant at Massena, N. Y., has been sold at Massena by Referee Lynch under foreclosure proceedings begun by the first mortgage bondholders. The plant was bid in by Mark T. Cox, of New York, representing the reorganization committee of the first and second mortgage bondholders, for $500,000. More than $10,000,000 have been expended in the Massena power scheme, and it is understood that English capitalists are the heaviest losers by the failure. All the capital stock was taken by Englishmen, and practically all the first and second mortgage bonds were sold to English speculators. The failure of the project was due to a lack of field in which to dispose of the company's current. Six million dollars were soon spent. Then $3,000,000 first mortgage bonds were issued and $1,500,000 second mortgage bonds. Two millions of the first mortgage bonds and $1,250,000 of the second mortgage bonds were taken by the English people. The plant was completed after $10,500,000 had been spent. When the interest on the first mortgage bonds came due on July 1, 1901, there was no money to pay the interest charges. Interest charges due on January 1 also went by default, and in February suit was begun by the Commercial Trust Company, of New Jersey, and the Morristown Trust Company to foreclose before Judge Coxe in the United States Circuit Court in Utica. The plant was ordered sold on May 13 by Judge Coxe. The bondholders who are in the reorganization turned their holdings over to Robert Winthrop & Co., of New York.

BALTIMORE CONSOLIDATION.—The entire system of electric railways in Baltimore and its suburbs is to be operated by power from the Susquehanna River, through a deal which involves the United Electric Light and Power Company and also the Mount Washington Electric Light Company. A syndicate, in which it is said New York as well as Philadelphia and Baltimore capital is interested, has been organized, under the financial direction of the Continental Trust Company, of Baltimore, to absorb the light and power companies and develop the Susquehanna plant. A contract has been signed between the Continental Trust Company and the railway company under which the latter is to receive the power for operating its lines from the Susquehanna Company. The price paid by the syndicate for the two lighting and power companies is about $900,000. It is said that the Susquehanna Company will have three plants of 40,000 hp each. The deal between the Continental Company and the United Railways assures the completion of the great works and the further development of a plan to furnish light and power to a number of Maryland towns as well as electric railway connections between several of them and Baltimore. In financial circles it is believed that the syndicate will ultimately control electric power and lighting in Baltimore. It will be some time, however, before the works will be constructed.

THE MICHIGAN TELEPHONE COMPANY, whose securities are held in major part by Chicago investors, has notified that it will default on its July interest. The company announces that it has not in its treasury sufficient funds to meet the interest on its $5,000,000 consolidated mortgage 5 per cent. bonds, payment of which is now due. A committee headed by N. W. Harris & Co. now requests holders of these bonds to deposit them with the Old Colony Trust Company of New York on or before July 21, with the view of combining for the protection of all concerned. This committee, however, is hopeful that the company will in the near future be able to meet its obligations. The mortgage securing the bonds provides for the sale of the property under foreclosure proceedings after default for ninety days in payment of interest. The committee believes that during this period either a satisfactory adjustment can be made with the American Telephone and Telegraph Company, or in the event that the Michigan property has to be sold in accordance with the terms of the mortgage a satisfactory price can be realized.

QUEENS BOROUGH COMPANY'S MORTGAGE.—There was filed in the office of the Clerk of Queens County last week a mortgage executed by the Queens Borough Gas and Electric Light Company, to the Guaranty Trust Company, of New York, for $2,000,000. The company has absorbed the rights, privileges, franchise and capital stock of the Queens Borough Electric Light and Power Company, and those of the Hempstead Electric Light Company. The bonds are to bear interest at 5 per cent. Of the total amount realized, the sum of $200,000 is to be devoted to acquiring the existing mortgage of the Queens Borough Electric Light and Power Company, and $200,000 for the acquirement of the mortgage of the Town of Hempstead Electric Light Company. The sum of $800,000 will be spent for the acquisition of further properties and the extension of the plant. A. H. Bronson is the president of the new company, and Nelson R. Theall secretary.

CUBAN TROLLEY CONCESSION.—W. H. Park and H. G. Hamilton, of Youngstown, Ohio, associated with Devott, Trimble & Co., and H. W. McDonald & Co., Chicago; G. F. Penhale & Co. and H. Whipple, New York, and W. J. Hayes & Son, Cleveland, Ohio, have received a franchise authorizing them to construct and operate electric railway lines through Havana, Cuba. The concessions are estimated to be valued at $25,000,000. Havana has already, however, a fairly large and complete trolley system.

POSTAL TELEGRAPH IN NEW AGREEMENT.—It was authoritatively announced this week that the new contract between the Postal Telegraph and the Pennsylvania Railroad Company had been duly signed. The contract is for fifteen years, and the Postal has already begun to handle some of the business.

JERSEY TROLLEY TUNNEL.—At the last meeting of the Rapid Transit Commissioners the special committee, composed of President Orr, Commissioner Charles Stewart Smith, and Controller Grout, reported favorably on the application of the New York and New Jersey Railroad Company for a franchise to build a tunnel under the North River, with a terminal in New York City. In their report the committeemen say the road will be glad to accept terms very similar to those granted to the Pennsylvania Railroad, and that, considering the relative importance and length of the two tunnels, the agreement with the projectors of the road is as advantageous to the city as that with the Pennsylvania Company. The assurances of the company's financial responsibility are satisfactory. The company proposes to construct and operate a road for the transportation of passengers and property, with two tracks, between New Jersey and New York. The property necessary for the terminal is to be purchased at the expense of the company, which has agreed to begin construction within three months after obtaining the necessary consents, and to have the railroad in working order within three years. Under a schedule compiled by the committee, the company is to make annual payments for the right to enter the city within the pier line, and for underground portions of the streets, at a rate of $14,386.50 for the first ten years, and for the next fifteen years at the rate of $25,673. At the end of twenty-five years the charges are to be readjusted and thereafter at intervals of twenty-five years. If the city and company cannot agree upon the rates at the times of readjustment, these are to be determined by the Supreme Court. The company is to pay the city, for the first ten years, 3 per cent. and for the next fifteen years 5 per cent. upon an estimate of its gross receipts from the traffic within the City of New York. A rough estimate and the franchise fixes this at $300,000 a year for the next twenty-five years.

OTTAWA ELECTRIC ANNUAL REPORT.—President T. Ahearn issues a very satisfactory report for the past year of the Ottawa (Canada) Electric Company, whose new plant was recently described in these pages. The report shows a gross revenue of $227,634, an increase of $31,271 over last year. The gross profit was $112,390, out of which $25,913 went to pay interest on bonds, etc., leaving the net profit $86,477. An amount of $75,000 was carried to the depreciation account, and it is evident that nothing stands in the way of dividend resumption this year, the company having fully recovered from the effects of the big lumber fire. In April, 1902, the company had 5,820 customers, using 104,407 incandescent lamps, 752 arcs, 24 heaters and 157 motors.

LONG ISLAND TROLLEYS.—Permission has been asked from the New York State Railroad Commission by the Mineola, Hempstead and Freeport Traction Company to issue $1,000,000 bonds and increase its stock from $125,000 to $1,000,000, to build about forty-six miles of railroad through Nassau County.

Commercial Intelligence.

THE WEEK IN TRADE.—The weather and crop conditions attracted the most attention during the week, adverse influences affecting different sections to help or depress trade. Throughout the northern half of the country, from the Atlantic coast to the Rocky Mountains, the cool, wet weather has injured or arrested crop development, held retail distribution and checked re-orders and fall business with jobbers. Central-Western bituminous coal operators are doing a rushing business. Lumber is rather quiet at the East, but stocks of all kinds are low; builders' hardware is still active. The situation in industrial lines has not materially changed. A favorable development has been the voluntary increase of wages to 100,000 men in the iron and steel industry. The anthracite coal strike continues in a half-hearted sort of fashion. Between the high prices for material and total absence of stocks, inquiries and business in iron and steel have suffered. A good volume of business in finished lines is reported, but most new business is in structural materials and rails for next year's delivery. *Bradstreet's* reports the number of failures for the week as 138, against 153 the previous week and 145 the same week last year. The copper market was somewhat easier, with sales of Lake as low as 12.40c. Electrolytic and casting stock were sold at 12.20c., being quoted at 12 @ 12¼c.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., notes the following among recent orders for direct current apparatus: Standard Steel Works, Burnham, Pa., two 200-kw generators; James Cooper Manufacturing Company, Montreal, Canada, 55-kw generator; Buda Foundry and Manufacturing Company, Harvey, Ill., one 240-kw generator; Whitehall Portland Cement Company, Cementon, Pa., 85-hp motor; Woodward & Lothrop, Washington, D. C., one 200-kw generator; two 150-kw generators, and one 75-kw generator; Sparrell Print, Boston, Mass., 14 motors of 3 to 10 hp; Tidewater Steel Company, Chester, Pa., one 250-kw generator; Minot Light and Telephone Company, Minot N. D., one 90-kw generator; Armour & Co., East St. Louis, Ill., four 50-hp motors and one 75-hp motor; Green Engine and Machine Company, Harrison, N. J., four 35-hp motors; Descubridora Mining and Smelting Company, Mexico, four 20-hp motors; Moline Malleable Iron Company, St. Charles, Ill., one 90-kw generator and 11 motors aggregating 125 hp; Pennsylvania Sugar Refinery, Philadelphia, Pa., 14 motors of 3 to 15 hp; Fretz Umbrella Works, Philadelphia, Pa., 80 motors in small sizes; Lake Shore and Michigan Southern Shops, Collinwood, Ohio, 11 motors aggregating 200 hp have been shipped to apply on the Crocker-Wheeler installation in this plant. Speed control will be obtained by the C.-W. system of multiple-voltage operation.

STEAM PUMPS—The annual report of the International Steam Pump Company for the year ended March 31 shows as follows:

Balance undivided profits last year		$1,962,350
Interest		21,802
Total		$1,984,152
Div'ds: Com. Int. Pump	$490,500	
H. R. Worthington	184	
		490,684
Balance last year's surplus		$1,493,468
Net profits for year		1,510,486
Less preferred dividends:		
International Steam Pump	$531,000	
H. R. Worthington	140,000	
Provision for debentures, interest, preferred dividend, and expenses, Blake & Knowles Steam Pump, Limited (unpaid)	105,050	
		776,050
Surplus		$734,436
Previous surplus		1,493,468
Total undivided profits		$2,227,904

President Dunn, in his annual statement, says: The manufacturing plants of the company have been taxed to their utmost to meet the increased demand. The orders on hand at the present time are largely in excess of the capacity of the works. During the year just closed the orders taken have been over 41 per cent. in excess of the orders taken during the preceding year. The unfilled orders at the end of the present fiscal year amount to $5,750,000, which is $3,500,000 in excess of the unfilled orders on March 31, 1901. It has been found necessary to substantially enlarge the plants. Additions have been made to some of the shops, and the erection of extensive new works has been begun at Harrison, N. J., for the Worthington Company, which will largely increase the present capacity of the Worthington plant. It is intended that the new works shall be the largest and best equipped pump manufacturing plant in the world. There has been purchased during the past year the Clayton Air Compressor Works, which has proved an important acquisition to the properties of the company. The outstanding 40 per cent. of stock of the Holly Company, except a small number of shares, has also been acquired in the process of reorganizing the affairs of the company.

NEW YORK CENTRAL SIGNALS.—The New York Central and Hudson River Railroad Company has awarded a contract to the Hall Signal Company for the equipment of its Putnam Division, from 155th Street to Yonkers, wth the Hall system of automatic electro-gas block signals, to be operated on the normal danger plan. The signal blades, or semaphore arms, are held by gravity to a horizontal position to indicate to the engineer danger ahead, or are drawn down to indicate safety, by carbonic acid gas pressure in a cylinder in each signal post. The gas is stored in liquid form in a tank underground beside the post. The valve controlling the flow of gas from the tank to the cylinder is closed or released by an electric current passing through the rails, and this is done automatically by the presence, or otherwise, of a train in the block ahead, and the approach of a train from behind. The electric connections are such that the signal blade stands normally at danger. When the locomotive approaches it the engineer sees the blade down at safety, if it is safe to go ahead, or the blade remains up at danger if there is a train, open switch, or a broken rail ahead.

ORDER FOR ALUMINUM CIRCUITS.—An important contract for aluminum wire has been closed between the Royal Aluminum Company and the Shawinigan Water & Power Company, for the Montreal power line. The length of this line will be eighty-four miles, and 1,000,000 pounds of aluminum will be required, the equivalent of 2,000,000 pounds of copper wire.

HARTFORD, CONN.—The Connecticut Railway & Light Company, Hartford Conn., is installing a storage battery plant of 260 cells to provide supplementary power for its line in the Derby and Ansonia district.

EXPORTS OF ELECTRICAL MATERIALS.—The following are the exports of electrical materials and machinery from the port of New York for the week ended July 5: Antwerp—15 pkgs. material, $1,160. Argentine Republic—8 pkgs. material, $523; 1 pkg. machinery, $41. Bremen—7 pkgs. material, $855. Brussels—2 pkgs. material, $118. Bilboa—1 pkg. material, $375. Bristol—11 pkgs. cable, $1,803. Bradford—2 pkgs. material, $33. British East Indies—19 pkgs. machinery, $1,302; 39 pkgs. material, $1,324. Brazil—34 pkgs. material, $154. British Australia—43 pkgs. machinery, $3,285; 89 pkgs. material, $7,920. British West Indies—14 pkgs. material, $376. British Possessions in Africa—1 pkg. machinery, $60; 12 pkgs. material, $414. British Guiana—21 pkgs. material, $485. Chili—32 pkgs. material, $1,122. Central America—13 pkgs. material, $70. Copenhagen—3 pkgs. material, $40; 2 pkgs. machinery, $23. Christiania—10 pkgs. machinery, $16. Cuba—2 pkgs. material, $114. Gothenburg—2 pkgs. machinery, $1,210; 7 pkgs. apparatus, $181. Glasgow—6 pkgs. material, $501; 45 pkgs. machinery, $3,570. Hull—9 pkgs. machinery, $760. Hong Kong—7 pkgs. machinery, $1,099. Havre—15 pkgs. material, $611; 7 pkgs. machinery, $935. Hamburg—2 pkgs. machinery, $105; 36 pkgs. material, $1,415. London—38 pkgs. machinery, $2,361; 266 pkgs. material, $5,288. Liverpool—367 pkgs. machinery, $27,041; 55 pkgs. material, $1,479. Mexico—46 pkgs. material, $2,655; 52 pkgs. machinery, $2,420; 1 pkg. machinery, $75. Marseilles—20 pkgs. material, $310. Nova Scotia—2 pkgs. machinery, $33. Peru—1 pkg. machinery, $35; 18 pkgs. material, $652. Stockholm—1 pkg. machinery, $60. U. S. Colombia—34 pkgs. material, $1,003. Venezuela—38 pkgs. material, $558.

CLARK AUTOMATIC TELEPHONE COMPANY.—The annual meeting of the stockholders of the Clark Automatic Telephone Swtichboard Company, Providence, R. I., was held on June 17th. The following officers were elected: Hon. E. L. Freeman, president; Mr. J. W. Phillips, vice-president; Mr. A. S. Clarke, secretary; Mr. M. E. Torrey, treasurer, and Mr. J. L. Putnam, manager. The following were elected directors for the ensuing year: Hon. E. L. Freeman, Mr. J. W. Phillips, Mr. A. S. Clarke, Mr. M. E. Torrey, Mr. E. M. Prindle, Mr. W. H. Herrick, Mr. W. S. Ballou, Mr. G. H. Smith, Mr. J. H. Preston, Mr. A. E. Farwell, Judge A. Van Wagenen and Mr. J. L. Putnam. The Clark Company now has established agencies in all the leading cities of the United States, Hawaii, Europe, South Africa, Australia and Mexico. Recent sales include the International Paper Company, Wilder, Vt.; the National Cash Register Company, Boston, Mass.; Canada Sugar Refining Company, Montreal; United States Trust Company, Boston, Mass.; the towns of Larchwood and Doon, Iowa; Messrs. Garteiz Hermanos, Yermo & Co., Gijon, Spain, and the East Haven Telephone and Electric Company, East Haven, Conn.

HYDRAULIC MINING having been prohibited by the national government in many parts of California, the hydraulic development companies are very profitably turning their attention to power and irrigation projects. The Central California Electric Company has recently purchased two 1,000-kw Westinghouse alternating-current generators, which will be direct connected to water wheels and used to supply power to Grass Valley, Nevada City, Sacramento and adjacent towns. This is the third station to be installed by the company, two other stations having now been in operation for a number of years. The Central California Electric Company's system is a part of that of the South Yuba Water Company, which controls 400 miles of main ditch line in the heart of the Sierra Nevada Mountains. Formerly the water was used for hydraulic mining, but this having been stopped on account of the filling up of the rivers with "slickens," the water now is sold to ranchers and fruit growers for irrigation purposes. Before being sold to the farmers, however, it is transmitted in pipes to stations at different points along the system where electric energy is produced and then conducted 35 to 50 miles to adjacent cities.

ROCKINGHAM COUNTY LIGHT AND POWER COMPANY'S EXTENSIONS.—The electrical engineering and contracting firm of Sanderson & Porter, 31 Nassau Street, New York, has just let contracts for equipment which will practically double the capacity of the Rockingham County Light and Power Company's plant at Portsmouth, N. H. The plant is intended to furnish the city of Portsmouth with power for both lighting and general use and to supply electric energy for the purpose of operating some 150 miles of street railways in that district, including the Exeter, Hampson, Anesbury, Newton, Haverhill, Lowell and Lawrence. The original plant is 4,000 hp. Additional contracts have been awarded for 3,000 hp. The Westinghouse Company will furnish a 3,000 hp vertical Corliss engine, which will be direct connected to a 2,000-kw, 13,200-volt General Electric generator. The boiler order has been given to Thayer & Co., Incorporated, of 39-41 Cortlandt Street. Babcock & Wilcox will supply the superheater. Roney stokers are to be used.

EQUIPMENT FOR TOKIO ROAD.—Barber & Company's steamship, "Border Knight," which is scheduled to sail for the far East June 14, will carry over 1,000 tons of equipment, etc., for the Tokio Densha Tetsuda Kabushika Kwaisha, the Japanese concern which, it will be recalled, is about to construct with American material a 22-mile electric traction system in Tokio. The contracts so far given out are valued at nearly $800,000 and were secured by the General Electric Company through the Japanese house of Mitsui & Company, which concern, whose New York offices are at Nos. 445-447 Broome street, is financing the contract. The shipment now going forward will include two 1200-kw generators, built by the General Electric Company, and two 1800-hp horizontal cross compound condensing engines, manufactured by McIntosh, Seymour & Company, of Auburn, N. Y. There will also be forwarded part of the pumps, heaters, condensers, wire, pipe, etc., requisitioned for in the contract.

TRADE WITH THE POSSESSIONS.—Commerce between the United States and its newly acquired territory is growing with remarkable rapidity. In 1897, the year preceding that in which Porto Rico, Hawaii and the Philippines came under the American flag, the shipments to those islands were, according to the figures of the Treasury Bureau of Statistics, $6,773,560. In 1901 they were over $30,000,000, and in the fiscal year just ended they will be, according to the best figures that the Bureau of Statistics can obtain, fully $35,000,000. To this may be added the estimate of $15,000,000 of shipments to Alaska in the last year. This would bring the total sales of American goods in the non-contiguous territory of the United States up to about $50,000,000 in the last fiscal year, against about $10,000,000 in that same territory in 1897.

BUCKEYE ENGINE ORDERS.—The Buckeye Engine Company, of Salem, Ohio, whose New York offices are under the management of Mr. Paul Bigelow, Taylor Building, has secured a contract from John Pierce calling for two 800-hp vertical cross compound engines for direct connection to 550-kw generators, to be built by the General Electric Company. These outfits are intended to be utilized for dry dock pumping purposes at Kittery Point, Me. The Buckeye Company has also recently obtained an order, through its New York offices, for a 700-hp vertical cross compound engine, to be direct connected to a 400-kw General Electric generator for installation in James Pyle & Son's Works at Greenwich and Vestry streets, New York. This equipment will be used for both light and power purposes.

THE INDUSTRIAL WORKS, of Bay City, Mich., one of the largest manufacturers of railroad wrecking cranes in the world, will shortly install a large amount of additional electrical apparatus for the operation of its shops. A recent purchase from the Westinghouse Electric and Manufacturing Company includes a 150-kw direct-current generator, which will be used to furnish current to eighteen or twenty direct-current motors already in use in the plant; a 200-kw two-phase alternator and a number of induction motors. The alternating current apparatus will be used entirely for power distribution. In addition to wrecking cranes the Industrial Works also manufacture smaller cranes and transfer tables.

BRAZILIAN ROAD TO HAVE AMERICAN EQUIPMENT.—The electrical engineering and contracting firm of James Mitchell & Co., Rio de Janeiro, which concern represents the Brazilian interests of the General Electric Company, the Pelton Water Wheel Company, McIntosh, Seymour & Co., the Peckham Truck Company, Babcock & Wilcox, etc., has been awarded a contract for the conversion of the lines of the Companhia Ferrocarril Santista, at present operated by mules, into an electric traction system.

WATER POWER FOR RUSSIAN MINES.—Mr. J. Stanley James, engineer of the Caucasus Copper Company, South Russia, is now in the United States for the purpose of closing contracts for a water-power plant to furnish power for operating the mines, now worked by steam. Mr. James is at present visiting the West, but will be in New York in about ten days' time. No contracts, it is understood, will be given out until he arrives at the Waldorf-Astoria.

CAHALL BOILERS.—The Boston offices of Thayer & Co., Incorporated, Eastern sales agents for the Cahall vertical water tube boilers, built by the Aultman & Taylor Machinery Company, have secured a contract for a 2,500-hp boiler plant for installation in the Woonsocket (R. I.) Electric Machine and Power Company's plant.

MONOGRAM SIGNS.—The Mason Monogram Company, of New York City, has recently been putting up some large signs, and has just finished one for the Anderson Food Company, Camden, N. J., which can be plainly read across the Delaware River in Philadelphia, and which is exciting favorable comment.

PHILADELPHIA SUBWAY.—President John B. Parsons, of the Philadelphia Rapid Transit Company, states that they expect to be in a position to advertise bids for the construction of the Market Street subway, between Broad and Twenty-third Streets, within the next sixty days.

FANS FOR FOREIGN TRADE.—The Federal Electric Company, 141 Broadway, has lately obtained some fair-sized contracts for both direct and alternating fans for export to London, England; Antwerp, Belgium, and Havre, France.

General News.

THE TELEPHONE.

TOMBSTONE, ARIZ.—Citizens of St. David, Ariz., and farmers of the vicinity have petitioned the Gila Valley Telephone Company to build a line to Tombstone. If the company will not construct the line, it is said an independent company will be formed.

SAN DIEGO, CALIF.—The Sunset Telephone Company will build a line from San Diego to Oceanside, Calif.

LOS ANGELES, CALIF.—A contract has been given to the Kellogg Switchboard & Supply Company for an additional 1,080 lines for the present equipment of the Los Angeles exchange. This will bring the capacity up to 7,080 lines.

WILMINGTON, DEL.—The American Telephone Company of Wilmington, Del., has been incorporated; capital stock, $300,000.

DOVER, DEL.—The Bourbon County Telephone Company has been incorporated to construct, maintain and operate telephone and telegraph lines in Paris County, Ky. Capital stock, $75,000.

WILMINGTON, DEL.—The Western Telephone & Telegraph Company, of Wilmington, Del., has been incorporated to construct, maintain and operate telephone and telegraph lines. Capital stock, $500,000.

ATLANTA, GA.—Comptroller-General Wright has rejected the returns of both the Postal and Western Union Telegraph companies, the comptroller averring that they are too small. An increase of about $131,000 is asked from the Western Union and $14,000 from the Postal.

BLOOMINGTON, ILL.—The Home Telephone Company of Bloomington has increased its capital from $30,000 to $100,000.

WINDSOR, ILL.—The Windsor Mutual Telephone Company of Windsor has been incorporated; capital stock, $3,000. Incorporators: H. S. Lily, A. C. Gays and B. F. Moberly.

CARLINVILLE, ILL.—The Carlinville Telephone Company has started the work of erecting a connecting line between the cities of Medora and Jerseyville by way of Fidelity.

MATTOON, ILL.—Six of the largest telephone companies in Edgar and Clark Counties have merged their plants into one concern, to be known as the Wabash Valley Telephone Company. The capital stock has been increased from $30,000 to $125,000. The officers of the new company are: President, H. H. Knipe, of Marshall; secretary, A. L. Keyes, Marshall; treasurer, James A. Earhart, Chrisman. Directors, George W. Fair, Charles Fair, A. K. Hartley, of Chrisman; A. L. Keyes and H. H. Knipe, of Marshall. The merger controls 1,700 telephones and the bonds for its consummation are already sold.

CLAY CITY, IND.—The Citizens' Telephone Company has been incorporated with $50,000 capital stock by John H. Klinger, S. M. Sibler, M. J. Murphy, S. L. Rowe, T. W. Engelhart and H. D. Falls.

NOBLESVILLE, IND.—The recent destructive storm destroyed many miles of telephone lines. The highways were blocked with poles and wires and the farmers chopped the poles from the roadway, necessitating hauling poles from a distance and stringing new wires. The telegraph companies met with a similar impairment. The Central Union Telephone Company's exchange at Alexandria was demolished by lightning, burning out the toll line switch-board and disabling many local and out-of-town instruments.

IOWA CITY, IA.—Iowa City and West Branch Mutual Telephone Company has been incorporated. Capital $2,000. J. T. Struble is president.

DES MOINES, IA.—The Mutual Telephone Company, heretofore an independent system, having nearly two thousand subscribers, was sold to a private company.

LOST NATION, IA.—The Lost Nation Telephone Company has been incorporated; capital, $5,000. Albert Daniel is president; W. C. Hohn, vice-president; L. Rutenbeck, secretary; Tim Appleton, treasurer.

VICTOR, IA.—The Victor Mutual Telephone Company has been organized in the eastern part of the county, with a paid-up capital of $2,000. T. T. McMillan, of Durham, is president; J. B. Lyman, secretary; R. G. Emmel, treasurer; directors, W. E. Foshier, Robert Converse, W. S. Huffman, R. P. Klein.

BURKESVILLE, KY.—The Gainsboro Telephone Company is putting in a new long distance line connecting Burkesville with Glasgow by way of Tompkinsville. An exchange will probably be established at Burkesville.

FORT SCOTT, KAN.—The Missouri and Kansas Telephone Company (Bell) has bought outright the toll lines of the Kansas Telephone Company, which has 350 miles of wire from Fort Scott to Parsons, and covering a field in Missouri and Kansas of which those towns and Iola and Garnett, Kan., Rich Hill and Nevada, Mo., and Pittsburg and Girard, Kan., are the principal points. The value of these toll lines is about $40,000. In connection with this deal the Bell Telephone Company made a traffic arrangement with the independent telephone company of Pittsburg, Kan., whereby the Bell exchange and the competing exchange there will consolidate their plants and one rate will be charged in place of two.

NEW ORLEANS, LA.—The committee on fire and lighting has reported unfavorably on two telephone ordinances—one for a franchise for the Telephone Company of America and a second known as the McFall ordinance for telephone privileges.

ANN ARBOR, MICH.—The Michigan Telephone Company is about to make extensive improvements in its station at Ann Arbor. An entire new office plant will probably be installed. The amount to be expended will be about $40,000.

MINNEAPOLIS, MINN.—By an order from Judge Elliott the Northwestern Telephone Company gets practically all it asked in the injunction suit against the Twin City Telephone Company to determine which has the right of way in certain sections of the atmosphere of Minneapolis. Wherever the Northwestern Company has established its lines first, the court holds, it is entitled to the exclusive use and enjoyment of the space between the top crossarm upon its poles and a point 20 feet from the ground. The Twin City Company is ordered to remove its wires at intersecting points in case they go under the Northwestern wires, and is further enjoined for the future from stringing any wires under those of the Northwestern Company.

MEXICO, MO.—G. T. Graham, late manager of the Mexico Telephone Co., will begin the construction of a number of exchanges in Northwestern Missouri about August 1. He will also continue the manufacture of a patent receiver of which he is the inventor.

ALBEMARLE, N. C.—The Albemarle Telephone Company has increased its capital to $10,000.

HENDERSON, N. C.—The town has refused a request for a franchise from the Bell Telephone Company. An independent company is already in the field.

BEATRICE, NEB.—The Nebraska Telephone Company has planned to build a new telephone exchange which will cost about $6,000.

FREMONT, NEB.—The city council has granted a franchise to J. L. Laird, B. W. Reynolds, C. S. Reynolds and others to build and maintain an independent telephone exchange.

HOPKINTON, N. H.—The Hopkinton Telephone Company will make extensions of its line to the Tyler district.

CLYDE, N. Y.—A new independent telephone company, capitalized at $50,000, has been organized by C. A. Lux for the purpose of purchasing and consolidating the various Wayne County telephone systems organized by Bishop Brothers.

NEW YORK, N. Y.—The Western Union Telegraph Co. is said to have raised the salaries of some 200 operators, chief operators and managers in New York since May 1, offsetting many reductions, dismissals, etc., since the new regime came in. Several old employees have been pensioned—a new thing, it is said.

NEWARK, OHIO.—The Newark Independent Telephone Company is arranging to put in a modern central energy system.

MARION, OHIO.—The Marion County Telephone Company has laid off part of its construction force. It is claimed that delay in the receipt of material makes this step necessary.

MONTPELIER, OHIO.—The Montpelier Telephone Company has purchased from the Williams County Toll Line Company lines from Angier to Beck's Corners, giving the company direct connection with Angier.

NEWARK, OHIO.—The Newark Telephone Company will prepare plans for an enlarged and improved system and it is probable that a central energy board will be installed.

CLEVELAND, OHIO.—H. H. Robinson, formerly general superintendent of the Central Union Telephone Company, with headquarters at Chicago, has been appointed assistant general manager of the United States Long Distance Telephone Company of Cleveland. The United States system covers the whole of Ohio and parts of Michigan, Indiana, Kentucky and West Virginia.

GREENVILLE, S. C.—The Citizens' Telephone Company, of Spartanburg, and the Home Telephone Company, of Greenville, were sold at auction recently by Mr. A. G. Furman, trustee, to satisfy a mortgage of $30,000, given on both plants by L. W. Floyd, of Newberry, and G. A. Browning, of Greenville. Both of the plants were purchased by Mr. Floyd; the one at Spartanburg for $23,000 nad the one at Greenville for $10,200, subject to the mortgage aggregating $5,224.

BALLINGER, TEX.—The Central Texas Telephone Company has increased its capital stock from $50,000 to $75,000.

EUREKA, TEX.—The Eureka Telephone Company has been incorporated with a capital stock of $4,000. The incorporators are J. A. Bonner, J. R. McComick, R. G. Goree, T. R. Harwell and C. J. McConinco.

NORFOLK, VA.—The Southern States Telephone Company has completed connections with the Tidewater Telephone Company of Gloucester C. H., Va.

WINCHESTER, VA.—The Winchester Telephone Company's plant, covering Frederick and Clarke Counties, in Virginia, and Berkely, Jefferson, and Hampshire Counties in West Virginia, has been sold to the United Telephone Company, of Philadelphia.

TACOMA, WASH.—It is stated that the new Northwest Telephone Company has raised $400,000 and is ready to begin building operations in Everett.

MADISON, WIS.—The Lisbon Telephone Company of the village of Sussex, Waukesha County, capital $720, has been incorporated by James R. Watson, Alex. Will, C. W. Weeks, W. D. McGill and G. C. Butler.

ELECTRIC LIGHT AND POWER.

CORONA, CALIF.—A petition is being circulated in Corona to ask the Board of Trustees to bond the city for $20,000 for the purpose of building a municipal electric light plant.

OAKLAND, CALIF.—The Southern Pacific Railroad Company has completed its new electric lighting system at the West Oakland railroad shops. In the roundhouse flexible cables enable all parts of the locomotives to be examined by electric light.

SAN JOSE, CALIF.—The Globe Light & Power Company which was recently incorporated in San Jose, with a capital stock of $200,000, by J. K. Curnow, H. W. McComas and others, purposes installing a water power electric plant in the high Sierras and operating a transmission line.

SAN FRANCISCO, CALIF.—During the visit of the Imperial Council of Mystic Shriners, about 10,000 Shelby 16-cp. lamps were used in the street illuminations, the lamps being strung in rows of 50 across Market Street at short intervals. The wiring and lamps will probably be used when the Knights of Pythias have their annual gathering in San Francisco in August next.

The 5,000 lights that have been permanently installed on the exterior of the City Hall dome produced a fine effect. The tower of the Ferry Depot was finely illuminated with 2,000 lights. Twelve extra transformers were installed by the Independent Electric Light & Power Company, which supplied the current. The Claus Spreckels building was handsomely illuminated.

GLENWOOD SPRINGS, COL., will soon vote on the question of a municipal electric light plant.

GEORGETOWN, COL.—The Clear Creek Light & Power Co. of Georgetown has made a number of extensive improvements in its plant. The company has acquired additional water rights. The controlling interest in the company has been bought by F. E. Himrod of New York, who is also interested in the Cascade Electric Company of Idaho Springs. The company is installing another 300-hp generator, and is building another line of poles from Georgetown to Idaho Springs. It is understood the new owners have in view a power plant in Grand County and may run wires 70 miles to the east side of the divide at Georgetown.

AUGUSTA, GA.—The council has decided to offer the Augusta Railway and Electric Company $70 per year each for arc lights, beginning July 1. Bids will also be called for supplying arc lights for terms of 3, 5, 10 and 20 years to begin July 1, 1903.

JACKSON, GA.—The Jackson Street Railway Company, incorporated in December, 1900, has just organized and will go ahead and transmit necessary power for electric lights contracted for with the city. Machinery for the street railway will be purchased at once.

VIRGINIA, ILL.—At a special election held July 2 it was voted to have electric lights.

LAFAYETTE, IND.—The Merchants' Electric Light Association, recently incorporated, has increased its capital stock from $30,000 to $150,000.

MADISON, IND.—The Madison Light Company, of this city, has incorporated with a capital of $75,000. John H. Brown heads the board of directors.

RICHMOND, IND.—The city council has appointed a committee to test the new municipal light plant and empowered it to employ an electric expert to assist in the work. This municipal enterprise has been in litigation from start to finish and the end is not yet in sight.

BALTIMORE, MD.—It is understood that an agreement has been reached for the purchase of the United Electric Light and Power Company by the Susquehanna Power Company of the $2,000,000 common stock of the former company which is held by the United Railways and Electric Company. The Continental Trust Company, it is said, will finance the deal. Three developments of 40,000-hp each are contemplated on the Susquehanna river.

CARROLLTON, MO.—The Carrollton water and light plant and the Carrollton street railway have been purchased by local capitalists and consolidated. The purchasers are Herndon Ely, P. L. Trotter, Lewis Ely, Vivian Ely, Thomas Marshall, T. L. West and W. R. Painter. The capital stock of the new company is $100,000 fully paid up.

HAZLEHURST, MISS.—The town has voted to approve the contract for a waterworks and electric light system. Work is now progressing.

ANACONDA, MONT.—A 800-hp motor has been placed in the Anaconda mine at Butte, Mont. Power is being furnished by the Missouri River Power Co.

BUTTE, MONT.—Electric power will take the place of steam in the large Neversweat mine in Butte. A 800-hp motor is already installed to run compressors. Power is furnished by the Canyon Ferry Power Company.

BUTTE, MONT.—A new company has been formed in Butte to supply the city with electric lights. The promotors are: Geo. Casey, J, H. Hesler and J. F. Cowan. They have located 1500 horse-power of water at Race Creek, about 25 miles from Butte.

BOZEMAN, MONT.—G. P. Dier, E. M. Ferris and others will erect a large power plant at Bozeman. The new company has taken up 5,500 inches of water in Hell Roaring Creek. Here the plant will be built and power transmitted to Bozeman and Belgrade. It has also planned to build an electric railway from Bozeman to Salesville and up the west Gallatin Canyon to the Yellowstone National Park.

NEW YORK, N. Y.—The East Hampton Electric Light Company, of East Hampton, has filed articles of incorporation with the Secretary of State. The capital stock is placed at $48,000. The directors for the first year are William A. Wheelock, Everett Howell, George E. Munroe, of New York City; George L. McAlpin, Schuyler S. Quackenbush, Cyrus W. Edlitz, Benjamin H. Van Scoy and Joseph S. Osborne, of East Hampton, and Henry A. James, of Lakewood.

COLUMBUS, OHIO.—Plans have been prepared by W. T. Mills for the plant to be erected by the Eastern Heating & Lighting Company.

COLUMBUS GROVE, OHIO.—A vote on the proposition of bonding the village for $15,000 to purchase the local lighting plant resulted favorably.

MANCHESTER, OHIO.—A special election for a vote on the proposition of bonding the town for $8,000 to build a lighting plant has resulted favorably.

SANDUSKY, OHIO.—Contracts will be closed in the near future for a new power house for the Erie County Children's Home. Plans have been prepared by Architect Marble.

FREMONT, OHIO.—The Home Electric Light & Power Company has been organized by Dr. Creager and E. B. Phillips to succeed the Creager Light Company. The company has secured a city franchise and will rebuild the old Creager plant at Ballville, installing new equipmentt throughout. Current will be furnished for lighting and power.

PITTSBURG, PA.—The borough of Coraopolis has advertised for bids for the construction of a municipal electric light plant which it is estimated will cost about $15,000. The plant will be under the supervision of the councils committee on lighting and will be equipped with generators operated by two automatic engines and a 200-horse power water tube boiler.

MERCUR, UTAH.—The Sacramento Mill Company at Mercur has installed electric motors to run the ore crushers.

SALT LAKE CITY, UTAH.—The Friday mine in eastern Oregon will build an electric power plant to furnish its mill and mine with power.

SALT LAKE CITY, UTAH.—The A. K. mine in Flathead County, Mont., will install a large power plant to operate its mining machinery. Power lines will be built 2,000 feet into the tunnels of the mine.

SALT LAKE CITY, UTAH.—Mahoney Bros., of Tekoa, Wash., have purchased from the Tekoa Cold Storage Power Company the electric light plant. The new managers will make entensive improvements.

SALT LAKE CITY, UTAH.—The Montreal & Boston Copper Company, which has just completed a large smelter at Boundery Falls, B. C., has erected a 250-kw Siemens-Halske generator driven by a high-speed Atlas engine for electric lighting purposes.

NORTH YAKIMA, UTAH.—J. F. McNaught has filed papers appropriating 1,000 cubic feet of water on the Natchez River, about 20 miles from North Yakima. A large power plant will be built, furnishing power for manufacturing purposes. This is preliminary to building the electric road from North Yakima to Sunnyside.

FOUNTAIN GREEN, UTAH.—The Big Springs Electric Light Company of Fountain Green, has been granted a franchise to build a pole line between this town and Moroni. The Western Electric Supply Company has secured the contract to supply the electric machinery. The power house will be located about 10 miles from Fountain Green, where a fall of water of 300 feet can be secured.

SALT LAKE CITY, UTAH.—Contracts have been let for the new electric pumping station to be erected at the head of Jordan River to supply water for irrigation purposes to the farmers of Salt Lake County. A dam will be built at that point costing $35,000. The plant will consist of 4 centrifugal pumps, and four 100-hp Westinghouse motors. Power will be furnished by the Telluride Power Company.

SPOKANE, WASH.—A complete electric plant for power and lighting has been installed on Dixie Creek by the Copperopolis Mining Company, of Spokane, Wash. Power is used for operating electric drills, compressors and hoists. To get a fall of 75 feet a ditch of 1300 feet was constructed.

MILWAUKEE, WIS.—A contract has been awarded by the Milwaukee Electric Railway & Light Company, Milwaukee, Wis., for a storage battery equipment for its lighting system in that city. The plant will, it is stated, cost $250,000. The company is about ready to let contracts for the erection of its new building on Sycamore Street, also for 1,000,000 feet of new conduits.

THE ELECTRIC RAILWAY.

SAN FRANCISCO, CALIF.—The United Railroads of San Francisco recently filed with the County Recorder at Redwood City a deed of trust to the Union Trust Company of San Francisco. The loan which was made amounted to $36,279,000, bearing four per cent. interest.

DENVER, COL.—The Denver Tramway Company has started work on its new $400,000 addition to the newly erected power house. It will double the size and capacity of the present structure. This is the first important step toward supplying with power the electric railways which are to connect Denver with the northern coal fields and mountain towns. Plans for the new power house were drawn by Engineer L. L. Summers, who came from Chicago to superintend the building of the plant recently completed.

FORT WAYNE, IND.—The Ft. Wayne & Southwestern Traction Company has filed a mortgage for $2,000,000 in favor of the State Street Trust Company, Boston, to secure bonds. The line from Ft. Wayne to Wabash is mortgaged for $1,000,000. The remainder will be held to cover future extensions.

INDIANAPOLIS, IND.—The Indianapolis Water Works will attempt by suit to hold the city of Indianapolis liable for the damages occurring to its mains for its failure to compel the local street railway company to provide return current circuits or some other change in its equipment that will protect water mains from electrolysis. The water company contends that the city has this authority under its charter and failing to exercise it renders it, instead of the street railway company, liable.

ALEXANDRIA, LA.—J. C. Allen is interested in a $50,000 proposed electric belt line. It is said that the General Electric Company of Atlanta will take about $20,000 stock. The road will be about four miles long.

NEW ORLEANS, LA.—The legislature has passed the "Jim Crow" car bill as relating to all street cars in the state providing for a partition separating the races.

ROCKVILLE, MD.—The Chevy Chase and Kensington electric railway, running from Kensington to Chevy Chase Lake, a distance of about two miles, and which has been in the hands of receivers for some months, has been sold to Mr. George E. Emmons, of Washington. It is understood that the track and rolling stock will be placed in first-class condition.

NEW YORK, N. Y.—The Union Railway Company will build a two-story brick power house on the east side of the Southern Boulevard. The cost is placed at $20,000.

NEW YORK, N. Y.—Thompson, Tenny & Crawford, of 25 Broad Street, are arranging an important consolidation of street railroads in New Hampshire. The proposed company will be known as the New Hampshire Traction Company.

URBANA, OHIO.—The county commissioners have granted a 25-year franchise to the Springfield, Piqua & Sidney Traction Company.

BATAVIA, OHIO.—The council has granted a franchise to the Cincinnati, Portsmouth & Georgetown Railway for its branch to Batavia.

NEW PHILADELPHIA, OHIO.—The Canton-Akron Electric Railway has been granted franchises through New Philadelphia and Strasburg.

DELAWARE, OHIO.—The Delaware, Berkshire & Sunbury Railway Company has secured franchises from councils at Delaware and Sunbury.

GENEVA, OHIO.—The village councils at Geneva and Madison have granted franchises through these towns to the Cleveland, Painesville & Ashtabula Railway.

YOUNGSTOWN, OHIO.—The Pennsylvania & Mahoning Valley Railway Cleveland Electric Railway Company have again voluntarily increased the wages of all employees. The new scale which took effect July 1 amounts to about 10 per cent.

CINCINNATI, OHIO.—A company is being formed by Charles Laval, of Evansville, Ind., C. C. Tennis, of Cincinnati and Charles Randall, of Dayton, to build an electric railway from Evansville, Ind., to a point on the Ohio river opposite Henderson, Ky.

YOUNGSTOWN, OHIO.—Messrs. Park and Hamilton, of this city, have received a cablegram from their representative in Havana announcing that franchises have been granted them authorizing them to construct and operate electric street railway lines throughout the city of Havana. The concessions are said to be worth fully $25,000,000 and include all the franchises in the city of Havanna.

CLEVELAND, OHIO.—The Cleveland, Richfield & Akron Transit Company, which is building a second line from Cleveland to Akron, has opened offices in the American Trust Building, in this city. Officers have been elected as follows: Charles T. Inmans, Akron, president; Horace B. Camp, Akron, vice-president; Daniel Gindelsperger, Cleveland, secretary; S. P. Inmans, Cleveland, treasurer.

PORTLAND, ORE.—The Portland City & Oregon Railway Company has decided to expend $5,000,000 on a new system of trolley roads, the trunk line of which will extend from Portland to Springwater, Clackamas County, Oregon, a distance of 35 miles via Gresham and Powell's Valley. Construction work will be commenced by July 15th. The company recently purchased two miles of water front property on the East Side in Portland, extending along the Willamette River. This will be used for terminal purposes.

SALT LAKE CITY, UTAH.—The Salt Lake & Bingham City Electric Railway Company has been granted a franchise by the County Commissioners of Davis County, Utah.

MIDDLEBOURNE, W. VA.—Capitalists interested in the proposed Middlebourne & Sisterville Electric Railway are having surveys made of the route.

THE AUTOMOBILE.

NEW YORK CITY.—The following board of directors has been elected by the Manhattan Transit Company: Lord Kintore, Equerry to the King; Lord Grey, Executor Rhodes will; Sir Charles Rivers Wilson, Chairman of the Grand Trunk Railway; C. S. Drummond, London Traction Company, all of London. Harold Walker, Walter G. A. Hemming, W. J. Arkell, W. K. Gillette, Walter H. Knight, James B. Brady, of New York, Senator P. H. McCarren, of Brooklyn, N. Y., New York directors. C. S. Drummond was elected president of the corporation and W. J. Arkell chairman of the board. The Atlantic Trust Company will issue certificates in exchange for the old General Carriage certificates, with the assessment paid, the plan having been successfully carried out.

NEW INDUSTRIAL COMPANIES.

THE AUTOMATIC HEATING AND LIGHTING COMPANY, of Cleveland, capital stock $300,000, has been incorporated.

THE MORRIS ELECTRICAL COMPANY, of Wilmington, Del., has been incorporated to deal in electrical goods; capital, $20,000.

THE DIAMOND AUTOMOBILE COMPANY, of Philadelphia, to manufacture vehicles of all kinds, has been incorporated; capital, $125,000.

THE AMERICAN THERMO-CALL COMPANY has been incorporated at Kittery, Me., to make and deal in electrical devices of all kinds; capital, $100,000. President, Horace Mitchell, Kittery, Me.; treasurer, A. M. Meloon, New Castle, N. H.

THE CONSOLIDATED FIRE ALARM COMPANY, New York, has been incorporated; capital, $2,500,000. Directors: Augustus D. Julliard, Thomas R. Brown, Manhattan; Bernard M. Ewing, Wyckoff, N. J.; Thomas R. Were, Maplewood, N. J., and Leroy L. Chuin, Montclair, N. J.

THE O. C. IRWIN ELECTRIC COMPANY has been formed in Crawfordsville, Ind., to manufacture electrical supplies. The capital stock is $50,000. The managers say the company will be able to supply electric lighting plants complete. The Irwin transformer will be made. O. C. Irwin is president of the new company.

OBITUARY.

ALBERT CLARKE WHITE.—We are informed of the death, on June 27, of A. C. White, general manager of the Providence Telephone Company, at the age of 61 years.

PERSONAL.

MR. WM. S. HORRY, electrical engineer for the Union Carbide Company, Niagara Falls, sailed on the steamer "Lucania," July 5, on a short trip to England.

MR. C. H. NORTH, of the North Electric Company, Cleveland, manufacturers of the well-known telephone apparatus bearing his name, was a visitor to New York a week ago.

LT. COM. B. A. FISKE, U. S. N., continues in the July "United Service" his intensely interesting and "human" story of the events at Manila after the great Dewey battle, in which he was an active participant. The narrative is most fascinating.

MR. T. W. WARNER, Muncie, Indiana, maker of the celebrated Warner ringer for telephone service, was one of the visitors at the Convention of the Independent Telephone Association recently held in Philadelphia, following which he spent a few days in New York before returning west.

MR. JOHN L. PUTNAM, manager of the Clark Automatic Telephone Company, was in New York this week on his way South. He is taking an extensive trip through the Southern and Central States, where the Clark system is meeting with great success.

MR. ALEX. HENDERSON has been made Master of Transportation for the National Electrical Contractors Association meeting at Philadelphia on July 16 and 17, and has issued notice of a special train from New York over the Jersey Central at 9:30 A. M. on July 16.

MR. J. C. IRWIN has just been appointed engineer of signals for the New York Central Railroad. He is a civil engineering graduate of the University of Pennsylvania, and has for some time been associated with steam railway, electric railway and signal work.

MR. W. R. MASON has resigned his position as agent for the Sprague Electric Company in Chicago and has accepted the position of Western manager for Coe, Smith & Co., selling agents for the Mechanical Boiler Cleaner Co., with offices in the Western Union Building, Chicago.

MR. J. W. PETERSON, who was formerly connected with the Chicago Sales Department of the Stanley Elec. Mfg. Co., and the Northern Electrical Mfg. Co. has been elected vice-president and general manager of the Electrical Equipment Co., with offices in the Monadnock Building, Chicago. The concern has several large contracts on hand for light and power plants.

MR. RAY D. LILLIBRIDGE, specialist in technical publicity, has moved from 20 Broad Street into the new Broadway-Maiden Lane Building, 170 Broadway, in order to provide accommodations in keeping with the steady increase in his business and facilities. Mr. Lillibridge has already succeeded in creating a large clientele of important concerns, for whom he has done excellent work.

COL. ALLAN C. BAKEWELL, second vice-president and general manager of the Sprague Electric Company, was recently elected Department Commander at the New York State Encampment of the G. A. R., held at Saratoga Springs. There was a strong opposition ticket in the field, but Col. Bakewell, in recognition of his services in both State and National work of the organization, was elected by a handsome majority.

MR. FREDERIC NICHOLLS, after enjoying a good time at the Cincinnati convention, went home to Toronto and plunged forthwith into a street railway strike. He was the only director in town when the strike took place, the military was called out, and it was 62 hours before he got a chance to rest. He would much rather have gone fishing, but it all ended well. He was also unable to attend the Canadian convention owing to the illness of one of his boys, but was represented there by two other sons. His many American friends have been heartily glad to learn that he has, is usual with him, pulled out in good shape.

EDUCATIONAL.

TROY POLYTECHNIC.—Prof. W. L. Robb has now assumed charge of the department of physics and electrical engineering at the Rensselaer Polytechnic Institute, Troy, N. Y. At its commencement last week, Trinity College, Hartford, Conn., conferred upon him the honorary degree of LL. D. in recognition of his work there and in the engineering field. He will have with him as assistants at Troy, Mr. E. D. N. Schulte and Mr. H. H. Rudd, the former an excellent electrical engineer and the latter a physicist who was assistant professor in physics at Trinity. This gives Rennsselaer an admirable teaching corps in a department which it expects to do it great honor.

Trade Notes.

THE ELECTRIC APPLIANCE COMPANY, Chicago, will be glad to have the name and address of those interested in wattmeters, who have failed to receive a copy of its new Gutmann alternating current watt-meter catalogue. It will be mailed promptly upon application.

MILLING MACHINE ATTACHMENTS constitute the subject of catalogue 5 and 6 of the Garvin Machine Company, New York. The various attachments are illustrated and briefly described. A copy of this catalogue should be kept handy for reference in every machine shop.

CATALOGUES WANTED.—Owing to a recent change in the office arrangements of the electrical department of the George A. Fuller Co., New York City, its catalogue file has become depleted, and it is now desirous of refilling it. Catalogues should be sent to the company in care of Mr. W. J. Martin.

ELECTRIC SIGNS.—"Profitable Advertising" devoted a large part of its June number to a consideration of the value and use of electrical signs for advertising purposes. The subject was well illustrated and the effectiveness of electricity was excellently brought out, from the advertiser's standpoint.

AMERICAN STEEL AND WIRE CO. has received a large number of awards from the South Carolina Inter-State and West Indian Exposition, including gold medals for its copper, iron, steel and aluminum wires and silver medals for its overhead and underground wires and cables. It also received a gold medal for machinery and appliances for drawing wire.

TOOLMAKERS' LATHE.—The Pratt & Whitney Company, Hartford, Conn., has issued a handsome catalogue descriptive of a new 10 in. x 5 ft. toolmakers' engine lathe which it is now placing on the market. The manufacturers claim that this is the most complete precision lathe ever produced for the toolmaker or modelmaker for all purposes where accuracy and convenience are essential.

PITTSBURG TRANSFORMERS.—The reasons why Pittsburgh transformers should be used where reliable service is demanded are pointed out briefly in a neat little pamphlet just issued by the Pittsburgh Transformer Company, Pittsburg, Pa. The front cover has an oval opening through which may be

seen a view of a packing case containing a transformer, a can of oil, and other boxed parts, all ready for shipment.

THE SANGAMO ELECTRIC CO., Springfield, Ill., manufacturers of the Gutmann integrating wattmeters, has been represented in New York recently by Mr. Jacob Bunn, Secretary of the company, and Mr. R. C. Lanphier, superintendent.

THE ENGINEERING OFFICES, San Francisco, will have charge of the electrical, mechanical and sanitary engineering features of the new mining building now in course of construction at the University of California in Berkeley. The Engineering Offices is the title under which business is now carried on by the electrical and engineering firm of Hunt, Meredith, Benjamin Cory & Allen.

THE OHIO BRASS COMPANY, of Mansfield, Ohio, has completed plans for an extensive addition to its plant. For some time the present facilities of the plant have been inadequate. The addition will be 175 feet long and 50 feet wide and three stories high. It will be used for general warehouse purposes. Another structure 350 feet long and 56 feet wide, three stories high, is contemplated to furnish additional machine shop facilities.

TELPHERAGE.—The United Telpherage Company. 20 Broad Street, New York, has just issued three interesting circulars describing and illustrating as many different applications of its system of electric transportation of goods, etc. Circular No. 22 is devoted to the handling of trunks and baggage at railway stations by telpherage; No. 23 is on the subject of cross country lines, an installation of this nature having been described and illustrated in our issue of June 21, and circular No. 24 is on the subject "Telphers in a paper mill."

WILLARD STORAGE BATTERY.—In a 20-page pamphlet just issued by the Willard Storage Battery Company, Cleveland, Ohio, the features of this battery are briefly pointed out, although the pamphlet is almost wholly devoted to tables giving the sizes, and much other information regarding the different types of cells manufactured by this company. The cells are artistically illustrated. Full directions for the setting-up and maintaining Willard batteries are given, which, when adhered to, will secure the most efficient service. Willard storage batteries are applicable to a great variety of uses.

JOHNSON & MORTON, Utica, N. Y., manufacturers of the "J. & M." standard junction boxes and auxiliary contact knife switches, have completed arrangements for adding two floors to their present building and erecting in addition a new one-story building, 50x100 feet. The latter will be so constructed as to permit two more stories to be added when required. These additions will give the firm floor space four times as great as they have at present. This extension of their plant indicates the growing demand for their goods. They have recently opened a New York office at 234 Greenwich Street and placed it in charge of Messrs. Frorup and Levy.

NEW ELECTRIC LOCOMOTIVE.—A test was made recently by the Westinghouse Electric & Mfg. Co. of a self-contained electric locomotive built for the Chesapeake and Maryland Railway, now under construction. The locomotive, which is in reality a complete power plant on wheels, consists of two cars, one of which contains a steam engine, oil being used for the generation of steam; a 220-kw generator and two 100-hp motors. The other car carries a storage battery which is charged when the locomotive is descending grades, and at other favorable times.

FOOTE, PIERSON & COMPANY, 82 Fulton Street, New York, have issued a 72-page catalogue, large octavo size, containing almost 300 illustrations of apparatus of their manufacture, or instruments, etc., the sale of which the firm makes a specialty. The catalogue is divided into two parts, Part I being somewhat general, while Part II is devoted entirely to measuring and testing instruments. In Part I is illustrated and described a complete line of telegraph instruments, not less than 56 cuts being used to illustrate the principal items. Following the section is a description of an anemometer electric clock, designed for determining the velocity of the wind, which gives a direct reading of the number of miles per hour. Next come call boxes and a line of telephone apparatus, followed by sections on house bells, push-buttons, gas-lighting apparatus, fuse protectors, lightning arresters, primary batteries, wires, etc. The section devoted to instruments includes all manner of galvanometers, condensers, shunts, resistance boxes, Röntgen ray apparatus, etc.

THE U. T. HUNGERFORD BRASS & COPPER CO., 121 Worth Street, New York, owing to encroachments by the Rapid Transit Commission, which is about to locate a subway station on a portion of the property at the above address, and the increasing demands of its business, has been compelled to seek larger quarters. It is about to move into the Hallenbeck Building, at the corner of Pearl and Park Streets. The company will occupy the basement, street floor and first floor above the street. There is also a new building now under way adjoining this structure, of which the company will have the three corresponding floors, giving it a total of about 30,000 square feet of floor space. Its largely increased facilities, close proximity to the business centers and shipping accommodations make possible the carrying of even greater stocks than heretofore and the prompt shipping of orders.

Record of Electrical Patents

UNITED STATES PATENTS ISSUED JULY 1, 1902.

[Conducted by Wm. A. Rosenbaum, Patent Attorney, 140 Nassau St., N. Y.]

Reissue, 12,007. SUPERVISORY SIGNAL FOR TELEPHONE SWITCHBOARDS; C. E. Scribner, Chicago, Ill. App. filed Dec. 5, 1899. App. filed for reissue Feb. 25, 1901. (See page 59.)

703,369. ELECTRIC INSTRUMENT FOR CAUTERY; W. B. Batcheller, Chicago, Ill. App. filed March 8, 1902. A pistol grip having a trigger by which the switch controlling the cautery instrument can be readily controlled.

703,420. PROCESS OF MAKING ELECTRIC ACCUMULATOR PLATES; R. M. Hunter, Philadelphia, Pa. App. filed Aug. 1, 1899. The process consists in coiling strips of lead into plugs, mounting them in a mold and while subjected to a cooling process, casting molten lead around them which fuses with the outer layers of the plug; the plate is afterwards "formed."

703,446. CONDUIT; W. L. McGowan, Philadelphia, Pa. App. filed Oct. 23, 1901. A conduit having a number of passages through it, built up of sections, each of which has one end convex and the other concave to interlock with each other.

703,447. CONDUIT; W. L. McGowan, Philadelphia, Pa. App. filed Feb. 8, 1902. A modification of the preceding patent.

703,467. ELECTRIC INCANDESCENT LAMP SOCKET; G. H. Proctor, Somerville, Mass. App. filed Feb. 28, 1902. An insulating lining for the cap of an incandescent lamp socket having projecting ears through which the screws which fasten the cap to the body, pass.

703,468. BRAKE FOR ADMINISTERING PRESCRIBED RESISTANCE TO THE STARTING MOVEMENTS OF HAND OPERATED CONTROLLERS; W. E. Quimby, New York, N. Y. App. filed Dec. 7, 1900. A vacuum cylinder and piston are geared to the controller shaft so that atmospheric pressure opposes the movement of the shaft and compels a slow motion thereof.

703,472. ELECTRIC LOW WATER ALARM; E. W. Rider, Detroit, Mich. App. filed July 24, 1901. A U-shaped expansion tube connects with the boiler at different levels and closes an alarm circuit by its expansion when the water drops below a certain level.

703,476. OVERHEAD TROLLEY; G. H. Russell, Pittsfield, Mass. App. filed Jan. 27, 1902. The bearings of the wheel are in dovetailed blocks which enter the harp and are held therein by spring catches.

703,490. STORAGE BATTERY; M. O. Smith, Depew, N. Y. App. filed July 13, 1901. A variation of that type of cell in which the plates are shaped like pans and placed one within the other.

703,515. ELECTRIC SWITCH; A. P. Anderson, New York, N. Y. App. filed June 6, 1901. The pivot of the blade is formed by a bolt having a chamber in its head for a spring which maintains good contact and prevents lost motion.

703,541. WATER PURIFIER; Chauncey Cook Clark, Philadelphia, Pa. App. filed Jan. 22, 1901. An electric current passes through the inflowing fluid.

703,563. GUARD FOR THIRD RAIL SYSTEMS; S. Elliott, Boston, Mass. App. filed April 3, 1902. Side guards rest upon the lower flange on each side of the third rail and are held in place by bolts passing through the guards and the rail web.

703,589. TROLLEY FOR ELECTRIC CARS; C. J. Johnson and C. W. Benedict, St. Louis, Mo. App. filed Sept. 23, 1901. Details.

703,623. ELECTROPLATING APPARATUS; Theodore F. Taylor, Camden, N. J. App. filed June 26, 1901. The articles to be plated are within a drum, the interior of which is lined with felt, over which is placed a series of wires electrically connected with one brush of the generator; the wires form the cathode with which the articles to be plated are always in contact. The drum is revolved upon a stationary axle and the anode is suspended within the cylinder from this axle.

703,649. SELF PROPELLED VEHICLE; E. R. Gill, Englewood, N. J. App. Nov. 11, 1899. The motive power of the vehicle consists of an electric motor applied directly to each wheel; the rotary part of the motor is rigidly attached to the wheel while the relatively fixed part is mounted in an annular bearing in the rotating part and is restrained by a flexible connection with the vehicle body which at the same time permits the wheel and motor to be turned in steering.

703,673. ELECTRIC BATTERY AND MOUNTING SAME; E. A. Sperry, Cleveland, O. App. filed Sept. 13, 1899. The negative plates are attached to the case, which is made of sheet lead and thus forms one terminal of the circuit.

703,674. CONNECTION FOR BATTERIES; E. A. Sperry, Cleveland, O. App. filed Sept. 13, 1899. Details.

703,691. ELECTRIC LOG REGISTER; W. B. Armstrong, San Francisco, Calif. App. filed Sept. 15, 1900. The apparatus includes certain indicating devices to show when the apparatus is deranged or not working.

703,692. MANUFACTURE OF CARBONS FOR ARC LAMPS; C. R. Boehm, Charlottenburg, near Berlin, Germany. App. filed April 12, 1902. (See Current News and Notes.)

703,700. TROLLEY WHEEL; W. F. Hall, Boston, Mass. App. filed April 29, 1902. A built-up wheel, the parts of which are held together by spring rings adjusted to a sleeve around the hub.

703,701. TROLLEY WHEEL; W. F. Hall, Boston, Mass. App. filed April 30, 1902. A modification of the preceding patent.

703,712. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Feb. 12, 1901. The receiving relay has two circuits, one of which includes a battery and the other a condenser which is charged by the battery when the circuit of the latter is closed. The reception of a number of impulses indicating a dash are thus transformed by the relay into a clearly defined dash, because the condenser discharges through the relay in the intervals between the closures of the battery circuit.

703,717. INCANDESCENT ELECTRIC LAMP AND SOCKET; J. C. M. Brown, Philadelphia, Pa. App. filed Feb. 28, 1902. Details.

703,777. CABLE TESTING APPARATUS; H. W. Fisher, Pittsburg, Pa. App. filed July 15, 1901. A hand switch to be used in connection with cable testing apparatus for conveniently throwing in successively the proper instruments and circuits for making the tests.

703,779. ELECTRIC RAILWAY; E. P. Frederick, St. Louis, Mo. App. filed March 20, 1902. The bond, which is a twisted wire, is secured to a coupling head by passing it into a chamber therein and then filling the chamber with molten metal.

703,782. TROLLEY FORK; E. L. Gentis, Newport News, Va. App. filed Feb. 21, 1902. The wheel is mounted to tip laterally when necessary.

703,786. APPARATUS FOR PREVENTING TROLLEY WHEELS FROM LEAVING THE FEED WIRE; G. W. Hammond, Philadelphia, Pa. App. filed March 3, 1902. Details.

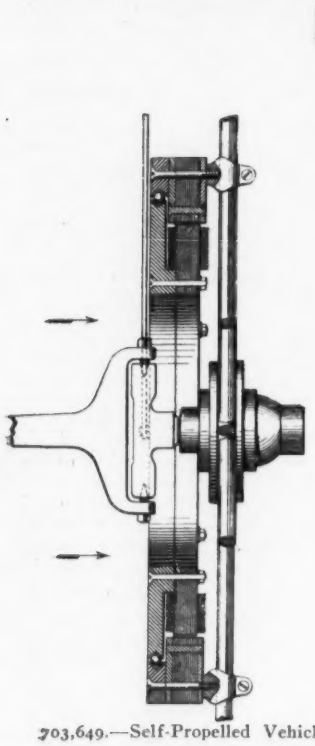
703,791. INCANDESCENT LAMP; H. J. Jaeger, New York, N. Y. App. filed Aug. 13, 1901. A telephone annunciator lamp having a thick translucent top, which takes the place of the usual translucent shield placed over the lamp in the switch board.

703,810. TELEGRAPHICALLY-OPERATED SIGNAL SYSTEM; J. N. Newsom, St. Louis, Mo. App. filed March 11, 1901. By means of this invention a train despatcher or signal man can set the semaphore signals by merely sending over the circuit Morse characters properly grouped to control the respective signals.

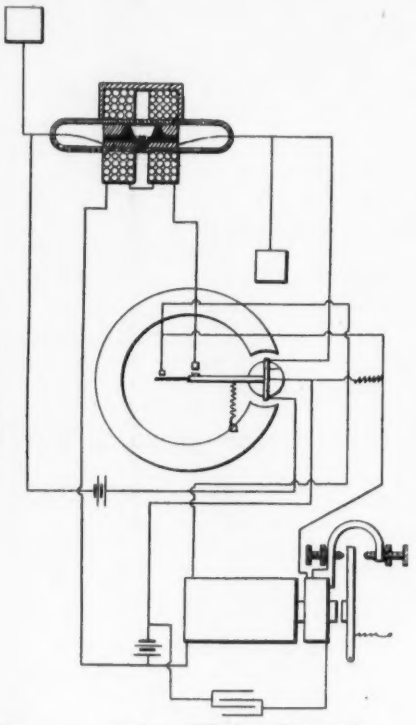
703,837. MANUFACTURE OF BRAIDED CORDS OR CABLES FOR ELECTRIC LIGHTING OR LIKE PURPOSES; C. Schurmann, Dusseldorf, Germany. App. filed Dec. 24, 1900. The insulating threads are braided around the individual wires of a cord or cable and at the same time interbraided with each other to hold the structure together.

703,842. WIRELESS TELEGRAPHY; H. Shoemaker, Philadelphia, Pa. App. filed Feb. 1, 1901. The sounder carries two circuits, one of which is closed when the coherer is actuated and the other, which includes a condenser, charged from the battery in the first circuit, is energized while the de-coherer is active; the sounder therefore indicates a dash when the usual rapidly recurring impulses representing the same are received.

703,857. ELECTROMETALLURGICAL TREATMENT OF ZINC ORES, AND ESPECIALLY BLENDE; C. J. Tossizza, Paris, France. App. filed Aug. 6, 1901. There are two processes, the first consisting in the electrolysis of the salt of zinc with the employment of soluble anodes of pure copper. Metallic zinc is thus obtained at the cathode while the anode dissolves with the production of copper sulphate. The voltage necessary for the operation is 1.1 volt at the minimum, rising to 1.5 volts with 40 amperes per square meter. The second operation reconstitutes the anode plates of copper, to which end they are used as cathodes in an electrolytic operation wherein the anodes are insoluble, the electrolyte being formed of the sulphate of copper produced in the first operation, which is preliminarily charged with sulphuric acid. The copper is deposited at a minimum voltage of .31 and for practical current densities has a voltage of about .5. Taken together the two operations permit the electrolysis of the zinc at a voltage the sum of which for the two operations has a minimum of 1.4 and a maximum of 2 volts.



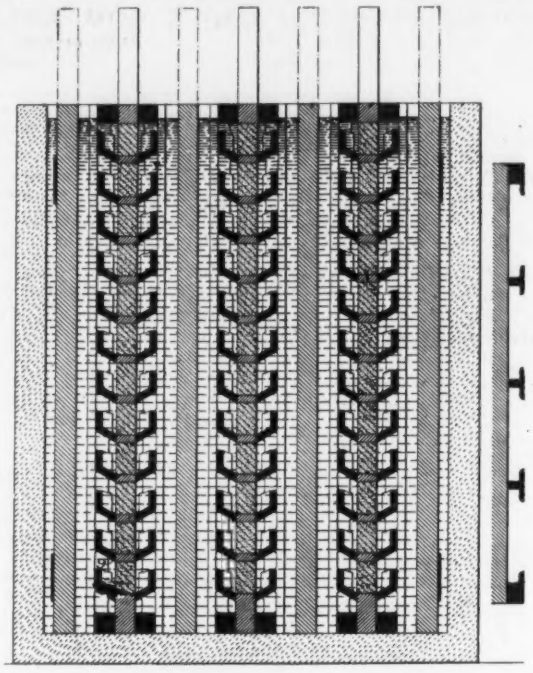
703,649.—Self-Propelled Vehicle.



703,842.—Wireless Telegraphy.

703,861. ELECTROLYTIC CELL AND ELECTRODE THEREFOR; August A. Vogelsang, Dresden, Germany. App. filed March 5, 1901. Enables all-platinum electrodes to be used economically. The cell is so constructed that the electrolyte passes alternately up and down between the electrodes, the end ones of which only are used for the inflow and outflow of current, the intermediate ones having no connection whatever with the external circuit. The electrodes consist of a slab composed mainly of an insulating material faced on each side with conducting strips of platinum, which strips alternate with exposed portions or surfaces of the body of the electrode.

703,875. ACTIVE MATERIAL FOR STORAGE BATTERIES AND PROCESS OF MAKING SAME; W. E. Winship, San Francisco, Cal. App. filed March 14, 1901. The process of forming an active material for storage batteries, consisting of suitably binding a mass of lead salt which will retain its conformation after immersion, and reducing it by electrolysis to spongy lead in an electrolyte which is a solvent for the lead salt, and from which solution lead trees essentially parallel to each other are plated out within the mass.



703,895.—Separator Plate for Secondary Batteries.

703,892. ELECTRIC TELEGRAPHY; S. G. Brown, London, England. App. filed Nov. 5, 1900. A number of transmitting instruments, a corresponding number of batteries adapted to be worked in series thereby, a similar number of recording instruments actuated by the combined effect of positive and negative impulses simultaneously transmitted and adapted to simultaneously register signals on one side or the other of their zero lines depending on the polarity of the currents sent by the transmitters.

703,895. SEPARATOR PLATE FOR SECONDARY BATTERIES; A. F. Clark, Philadelphia, Pa. App. filed Oct. 18, 1900. The separators have pockets which receive the active material that becomes detached from the plate, thereby preventing it from falling to the bottom and short-circuiting the cell.

703,902. PROTECTING DEVICE FOR INDUCTION MOTORS; J. H. Diggle, Lasalle, Ill. App. filed Oct. 21, 1901. A switch whereby a heavy fuse can be thrown into circuit in starting the motor and a lighter fuse afterwards thrown in to serve under running conditions.

703,909. AUTOMATIC FIRE ALARM; M. K. Fred, Bandera, Texas. App. filed March 22, 1902. Metallic links are suspended from two conductors which are strung through the area to be protected, said links being partially covered by insulating material and looped together in a manner to prevent contact between their metallic parts. Excessive temperature melts the connecting device between the links and allows them to assume a position under the action of gravity, where they will be in contact with each other and thus close an alarm circuit.

703,921. TROLLEY POLE; J. D. Hickman, Anderson, Ind. App. filed Oct. 11, 1901. The harp is pivoted to the upper end of the pole in such manner that the wheel can be disconnected from the wire by lowering the harp without moving the pole.

703,942. ELECTRIC MOTOR POWER TRANSMITTING DEVICE; H. S. Miller and G. C. Marx, Elizabeth, N. J. App. filed Nov. 30, 1901. A sewing machine motor having a brake and a circuit controller operated by a single lever.

703,953. SELF-WINDING ELECTRIC CLOCK; C. M. Crook, Bristol, Conn. App. filed March 9, 1901. The time train and the striking train are wound by power derived from the same electro-magnet and by the same movement of the magnet armature.

703,957. SEMAPHORE INDICATOR FOR ELECTRIC SIGNALING; H. Gulliver, South Yarra, Melbourne, Victoria, Australia. App. filed April 23, 1902. Details.

703,970. ELECTRICAL HEATING APPARATUS; J. R. Quain, Middlesex County, England. App. filed March 10, 1902. A tubular apparatus in which the passages are surrounded by heating coils for the purpose of heating liquids flowing through the tubes.